Phillip Lockwood

Tips and Tricks for the Ideal 912 Installation Part 3

This article is a continuation of our Rotax 912 installation series. In the first article (August 2005), we discussed the primary differences between the Rotax 912UL, 912ULS, and 914UL engines and how to determine which is best for your application. We also discussed various operating parameters and limitations as well as the ideal markings for the various engine instruments.

In the second article (September 2005), we discussed exhaust system basics including EGT limits and the importance of propeller balancing. We also covered some of the do's and don'ts of the oil lubrication system and Rotax Service Instruction SI -04-1997 R3, which explains how to purge the oil lubrication system of air. Now, let's move on to discuss the carburetor and fuel system and starters and batteries. Next month we'll conclude our series by investigating the 9-series engines' electrical systems, liquid cooling systems, and tips on how to install the Rotax ring mount.

The Bing 64 constant velocity carburetors are sprung to full throttle on the 9-series engines. This carb was photographed at full throttle. The vent line must be vented to the same pressure air as that entering the carburetor.

Carburetor and Fuel System Basics

The 9-series Rotax engines use two Bing 64 constant velocity carburetors. As mentioned in earlier articles, two carburetor-related items are commonly overlooked or set up incorrectly:

1. The carburetors are often not synchronized, which causes reduced gearbox life; depending on how far out of sync they are, a rough idle situation can also develop. Read the two-part article in the April and May 2004 issues of *EAA Sport Pilot & Light-Sport Aircraft* for a detailed description of the carburetor synchronizing procedure.

2. The carburetor idle speed is often set too low. It should be set between 1400 and 1800 rpm, depending on the weight of the propeller.

When you remove a new 9-series engine from its shipping container, the carbs are set at full throttle until you hook up the throttle linkage and pull the throttle arms back to idle. Do not attempt to start the engine until the throttle linkage has been properly connected.

The clear plastic vent line, shown in Photo 1, must be vented to the same pressure air as that entering the carburetor. If your installation uses a K&N air filter on each carburetor, without an air box, you must leave the vent line end at the carburetor. This is how the carbs are set up from the factory. The K&N air filters cause a minimal drop in pressure, so venting the carb float bowl next to the carb works fine. Some owners make the mistake of extending these vent lines (one per carb) down to the belly of the aircraft; that may seem like a good idea, but it is not. Extending the carb vent lines in this fashion will cause the engine to run poorly because of the pressure differential between the carburetors and the belly with its higher velocity air stream (increased velocity causes reduced pressure).

When using an air box, the carburetor vent lines must then be connected to the air box.

While we're talking about the air box, I'll mention some of the benefits of installing one. The Rotax air box helps to stabilize the carburetors, improving the life of the carb sockets and helping to maintain proper carb synchronization. An air box offers the possibility of increased performance on most cowled tractor aircraft because it can be designed to supply cool outside air. Some designs offer improved breathing through a single, large, low-restriction K&N air filter. You must use some type of filter, which should be bypassed when the carb heat is activated. The air box also allows for carb heat, and although the 912UL and 912ULS are not prone to carburetor icing, it can occur under the right conditions.

If your aircraft does not have an air box, there is another way to deliver carb heat. This alternative system uses a water jacket installed on the carburetor body that uses hot coolant from the engine to heat the butterfly end of the carburetor. This system is available through Lockwood Aviation Supply.

Enclosed engine installations often require more attention to heat shielding than the uncowled engines found on some pusher aircraft. Cowled engines should have a metal pan under each carburetor float bowl to prevent heat from the exhaust pipes from boiling the fuel out of the float bowls after shutdown. The Rotax air box comes equipped with a combination drip tray/heat shield that also incorporates a drain fitting. A tube is attached to this fitting and extended to a suitable location, such as the belly of the aircraft, to safely drain any fuel discharged from the carburetor should it malfunction.

On aircraft without an air box, use two individual K&N air filters instead—one attached to each carburetor; care should be taken to assure the carb vent line will drain into the drip tray under the carb and not onto the hot exhaust pipes.

Rotax does make an under carb drip tray that can be installed without an air box. It is part of the Rotax 914 package (Rotax Part No. 874 300), but it can be purchased separately and installed on the 912UL and 912ULS engines.

Some type of fire sleeve should protect fuel lines located within the engine compartment. A fire sleeve offers a number of important benefits:

1. Most types of over-line fire sleeves add significant protection against abrasion, which is a common cause of fuel leaks. Fuel leaks can lead to fire and/or engine failure, neither of which make for a good day.

2. Because of its insulating properties, the addition of a fire sleeve reduces the chances of vapor lock.

3. Fuel lines protected with a fire sleeve are less likely to

When using the Rotax air box, or any air box, the carburetor vent lines must be connected to the air box so the pressure in the float chamber will be the same as that of the air entering the carburetors. Note the Rotax under carb drip pan/heat shield that comes with the Rotax air box assembly.

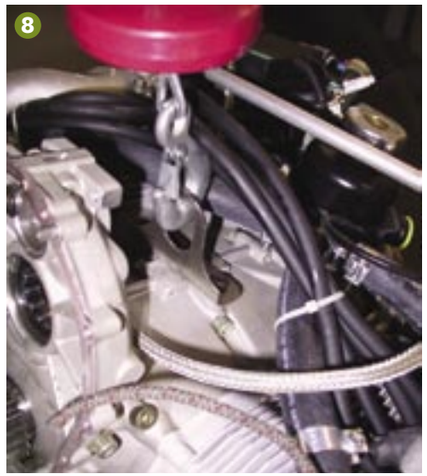
Some airframe manufactures provide their own under carb drip tray/heat shield as does Flight Design on its CT.

This under carb drip tray/heat shield comes standard as part of the Rotax 914 engine package, Rotax Part No. 874 300. It can be purchased separately for installation on the 912UL and 912ULS.

Inexpensive fuel line, like this clear Tygon, is not suitable for use within a hot engine compartment. Spend a few extra bucks and install the more durable Aeroquip fuel line pictured here or an equivalent. Enclosed engine compartments should have the fuel lines protected with aircraft-style fire sleeve like the orange material shown here.

The older carb socket, pictured on the left, must have its clamp tightened to leave a 7-mm gap. The correct gap can be easily measured using a 7-mm Allen wrench. The new style 912 carb socket, pictured on the right, can be easily identified by the spacer fitted between the clamp halves. This new socket is slightly thicker and requires an 8-mm gap between the clam halves, which is set by the 8-mm spacer.

This lifting bracket, available from Lockwood Aviation Supply, makes it easier to use a portable hoist to lift the engine onto the engine mount.



rupture in the event of an engine compartment fire.

The ASTM consensus standards for special light-sport aircraft require fire protection on the engine compartment fuel lines. Fire sleeves can also be placed over oil lines and should, at a minimum, be placed over the oil and coolant lines where they pass in close proximity to an exhaust pipe in an enclosed engine compartment.

For maximum effectiveness on fully sleeved hoses, the fire sleeve must cover the ends of the fittings, and the cut ends should be sealed. Special sealants are available, but in most cases, owners of non-type-certificated aircraft will simply use high-temperature silicone sealant to prevent the exposed inner fiberglass insulation from wicking in fluids. Use metal bands to hold the ends of the fire sleeve in place. These bands are resistant to high temperatures and will contain a fire longer. Avoid using inexpensive vinyl fuel line within the engine compartment and in places where the line will be difficult to replace.

The 912UL and 912ULS engines use a pair of rubber sockets to mount the carburetors and isolate them from excessive heat and vibration. The tightness of the circular carb socket clamp is important. If the clamp is too tight, the rubber socket will tear at the edge of the clamp.

The clamps come properly adjusted from the factory, so the main concern is over tightening, which many non-owner's-manual-reading but fastidious installers do as they are making their final adjustments. The correct way to check and adjust the clamping force is by measuring the gap between the clamp halves at the adjustment screw. The older clamps should have a 7-mm gap. Simply place a 7-mm Allen wrench between the clamp halves to check the gap. The newer sockets are a bit thicker and have a spacer to prohibit over tightening. They are set at an 8-mm gap, which is easy to achieve because you just tighten until you hit the spacer.

There are a number of ways to lift a 912 out of the shipping box, but certainly the easiest is with a portable hoist. If this is an option for you, consider purchasing one of these nifty lifting brackets (Photos 7 and 8). If you are going to move the engine with human power, you'll need at least two people with strong backs and a third to slide the engine mount bolts in place. The 912 engines are comparatively light, but lifting and holding approximately 130 pounds still takes a bit of muscle, and you don't want to drop your new 912.

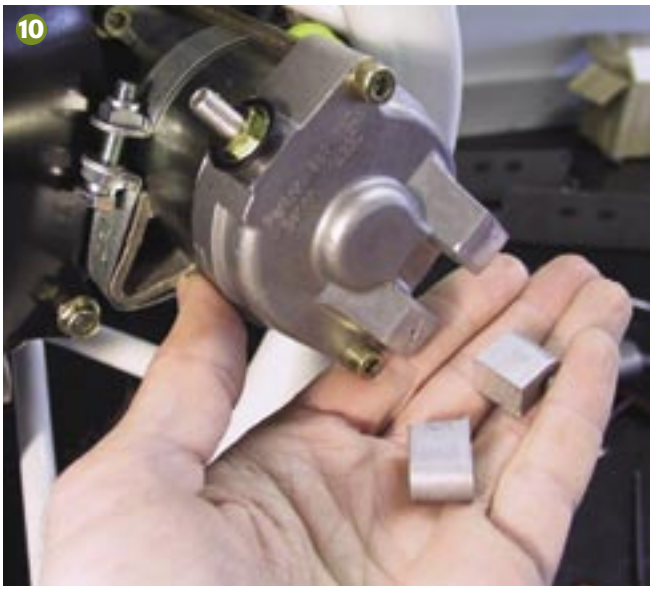
Starters and Batteries

Since 2004, the 912ULS engines have been equipped with a new, high-torque starter, which is approximately 1-3/8 inches (or 3.5 cm) longer and 1 pound heavier than the old starter (Photo 9).

If you have an engine mount designed around the smaller starter and the extra length is causing a clearance problem, you can cut the protruding aluminum parts off the new starter as they are not required in this application. See Photo 10 on page 32. This will shorten the starter to within about 9/16 inch or 1.5 cm of the old starter's length. You can tell which one you have by the color. The new high-torque starter is gold in color and is only used on the 912ULS. The other starter is painted black and is still standard on the 912UL and the 914UL.

The high-torque starter can be retrofitted to older engines and is available through the Rotax service centers. The new starter will make startups quicker but is only mandatory if you have the 30-degree dog hubs with the overload clutch in your gearbox. This item has been standard equipment on 912ULS engines purchased in the United States through Kodak Research

The gold high-torque starter is standard on new 912ULS engines. Some older engine mounts may require modification to accommodate its additional 1-3/8-inch length.



The new high-torque starter can be shortened to within 9/16-inch of the smaller starter.

Weighing only 10.6 pounds, this compact 13-amp-hour Genesis battery is sealed and capable of easily starting a Rotax 912ULS. The blue-topped Power-Sonic battery weighs 16 pounds and is twice the size, but at 26 amps has double the capacity. Both batteries do a great job of cranking the high-compression 912ULS engine.

and its authorized service centers since 2004.

Choosing the right battery is a balance between weight, cost, and reserve capacity measured in amp hours. Some modern batteries, like the all-black Genesis shown in Photo 11, use thin metal film technology that dramatically increases the amount of lead surface area exposed to the acid electrolytes. This design makes it possible for a small, lightweight battery to put out a tremendous amount of current over a short period of time for engine starting. As a result, some modern small batteries can do the job once relegated to much larger batteries with higher amp-hour ratings.

A good comparison can be made between the two batteries pictured in Photo 11. Both are high quality, sealed, lead-acid batteries, and both sell for about $120. A sealed battery is a good idea because you don't want acid venting anywhere in or around your airplane. The 26-amp-hour Power-Sonic battery will also do a good job of starting the high-compression Rotax 912ULS engine. The difference is in the size, weight, and total power capacity. The Power-Sonic (5 inches high by 6-1/2 inches wide by 6-7/8 inches deep) is twice the size of the Genesis (5 inches high by 6-7/8 inches long by 3-1/4 inches wide) and has double the capacity at 26 amps versus 13 amps and weighs 5.4 pounds more. If you need the extra reserve capacity, use the Power-Sonic. If compact size and light weight are more important, use the high-current Genesis, which will crank the engine just as fast as the larger Power-Sonic.

Cheaper batteries are available, but they are often not sealed, are less effective at delivering current to the starter, and tend to have a shorter useful life.

If you are doing your own wiring, have an electrical expert help determine the correct gauge for wire from the battery to the starter solenoid and from the solenoid to the starter. Also make certain the ground wire from the engine is sufficient to carry the current from the starter back to ground. If the distance between the battery and starter is long enough, you could need as much as No. 6 gauge wire. Poor connections or insufficient wire size will limit starter motor performance, making starting difficult.

Next month: some electrical system basics, some final tips on fine-tuning your cooling system, and tips on how to install the Rotax ring mount.

This series of articles is written to complement the Rotax installation and operator manuals. All of the Rotax manuals are shipped on a CD with each new engine. They also can be found online at *www.rotax-owner.com* or *www.Rotax-aircraft-engines.com*; look under documentation. The latest versions of the manuals are always available online. Don't be fooled by the cover date, which often remains the same even as updates are made. **Rotax has not reviewed or approved the contents of this article.**

Each month in Power ON, **Phillip Lockwood**, president of Lockwood Aviation Repair (*lockwood@digital.net*, *www.lockwood-aviation.com*), will address common Rotax engine maintenance or operation issues. In addition, readers are invited to send their questions about various alternative engines to our panel of engine "answer men" or to *editorial@eaa.org*, or

- For HKS engines, write **Dana Persiani**, *danapersiani@yahoo.com.*
- For 1/2 VW engines, write **Bill Bronson**, *onehalfvwguy@sbcglobal.net*
- For Corvair engines, write **William Wynne**, *WilliamTCA,@aol.com.*
- For Subaru engines, write **Don Bouchard**, *dbouchard@earthlink.net.*
- For Hirth engines, write **Matt Dandar**, *rpe@bpsom.com.*
- For (non-Rotax) two-stroke engines, write **Torello Tacchi**, *tacchi88@bellsouth.net.*

We'll reprint questions and answers of interest in upcoming Power ON columns.