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Tips and Tricks for the Ideal Rotax 912 Installation

Part 4

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.

In the third article (November 2005), we discussed the carburetor and fuel system and starters and batteries. This month we'll conclude our series by investigating the 9-series engines' electrical systems and liquid-cooling systems, and by offering some tips on how to install the Rotax ring mount.

The 912 Electrical System: Course 101

The 9-series Rotax aircraft engines have a self-sustaining dual-electronic ignition system that does not require power from the battery to run. Each of the two ignition systems is powered by independent, stationary generating coils located on the ignition housing behind the flywheel. The coils are excited by magnets permanently mounted in the flywheel. Aside from the flywheel, which is mounted directly to the crankshaft, there are no moving parts to wear out in this ignition system: no gears, belts, seals, or bearings. A third set of independent coils provide alternating current (AC) to an external rectifier-regulator that converts it to 14-volt direct current (DC) and regulates the amperage delivered to the battery, based on demand. Expect a maximum output of approximately 18 amps and limit your total electrical load, with all accessories, to less than 80 percent of that, or 14 amps.

Need more power? No problem. You can add an optional external 40-amp alternator (see no. 9 on illustration 1b) and feel free to spend a fortune at your local avionics shop. But, do not run the two charging systems together. You can use the internal, 18-amp system as a backup charging system by controlling both with a three-position, panel-mounted switch. Label the switch alternators as follows:

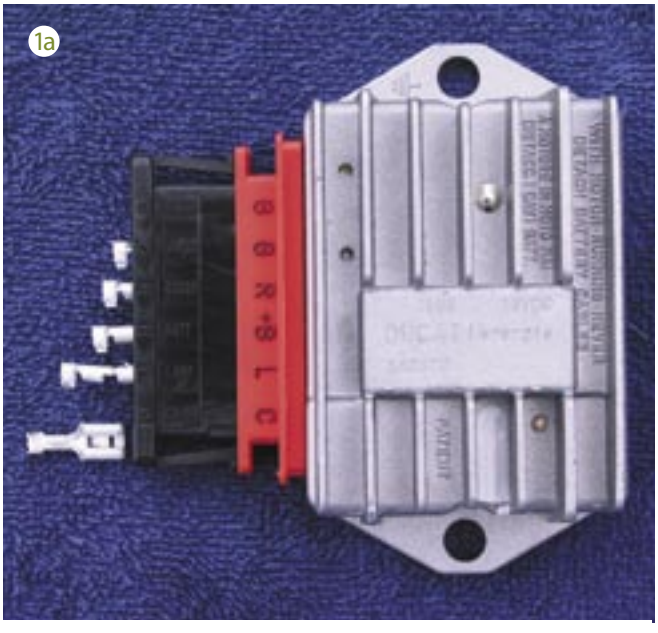
Up position: Main 40-amp alternator on.

Center position: Charging system off.

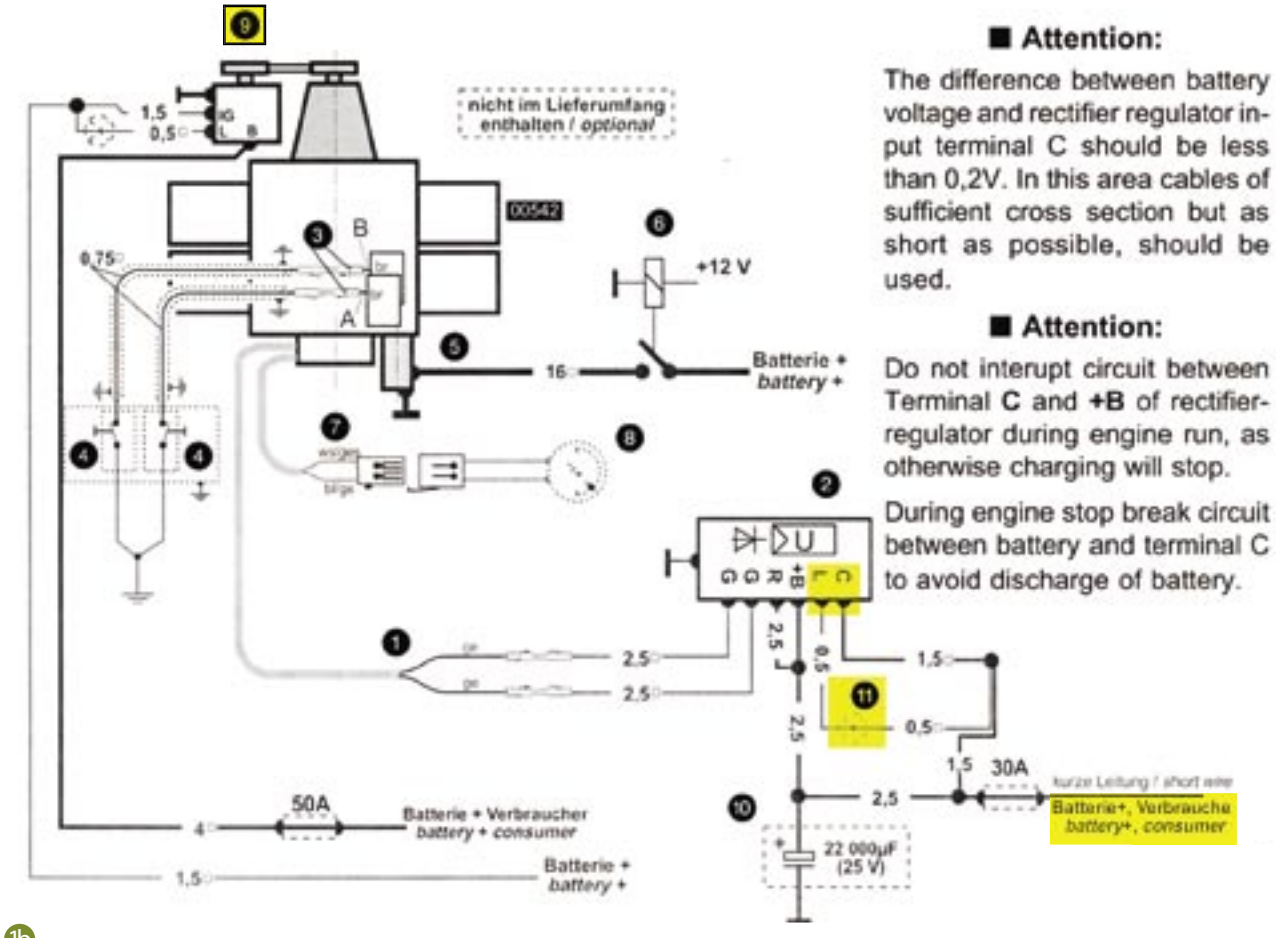
Bottom position: Emergency 18-amp alternator on.

You will need to use the remote electric solenoid that comes with the external alternator kit. Do not attempt to run the 40 amps from the external alternator through the panel-mounted switch. 1b

The two yellow wires (see photo 2) surrounded in stainless steel



This Ducati rectifier-regulator is used to convert alternating current (AC) from the 912's internal generator to 12-volt direct current (DC) to power electronic accessories and charge the aircraft battery.



1b

The Rotax 912 wiring diagram is quite good and requires only two points of clarification as noted in the text of this article.

braided shielding are the AC charging wires from the standard 250-watt internal coils. They will be connected to the external rectifier that will charge the battery (see photo 1a). If you must extend these yellow wires, you must also extend any shielding to avoid radio and intercom noise because they carry AC current. This is often done on pusher installations (engine mounted in back) where the regulator can be mounted farther from the engine. See the above wiring diagram (page 17-1 of the current Rotax 912S installation manual). This diagram is quite good and needs only two points of clarification.

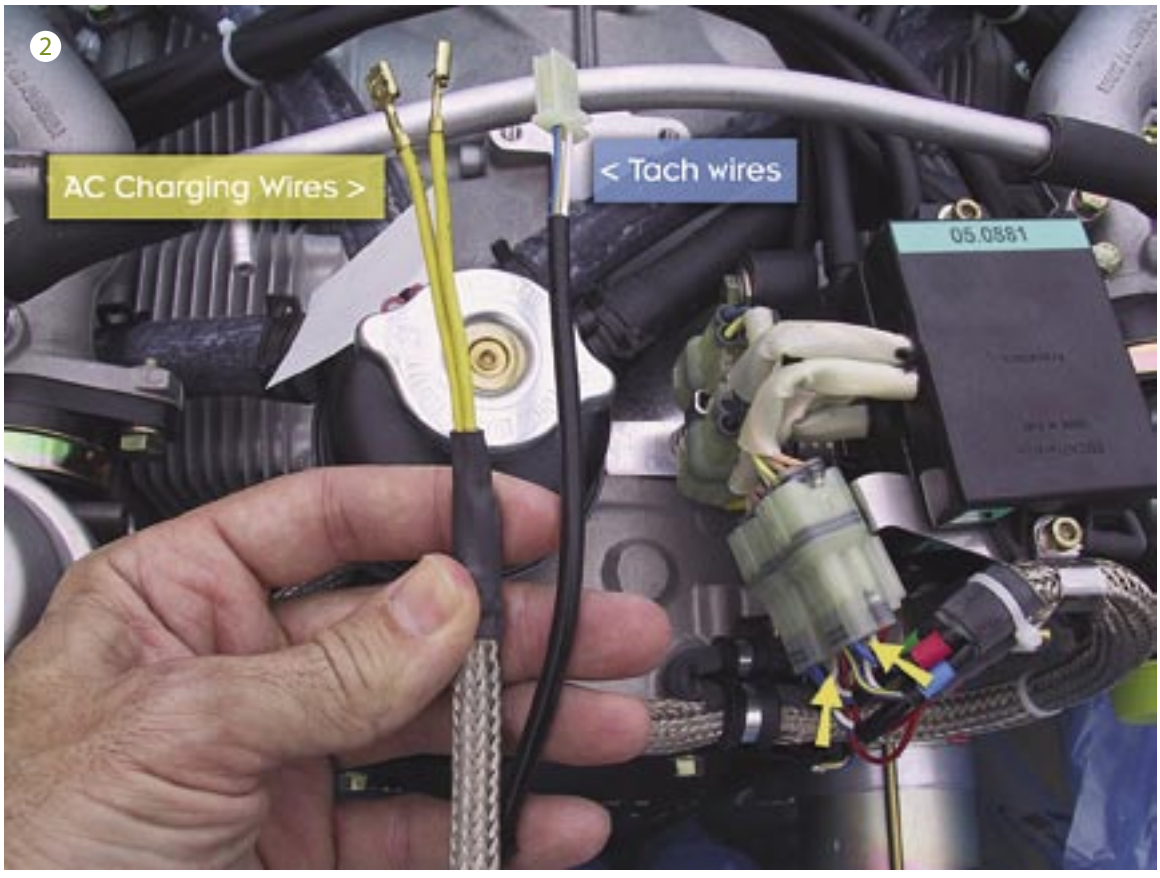
1. The positive charging wire, referred to as (battery +, consumer on the Rotax wiring diagram), which is connected to terminals R, B+ and C on the regulator-rectifier, must not remain connected to the positive side of the battery when the master switch is turned off or the battery will discharge while the engine is not running. This caution is mentioned in the copy adjacent to the diagram, but some people miss it.

2. The wiring diagram shows a "charge indicating lamp," number 11, connected between terminals L and C on the rectifier-regulator. There is a lot of confusion about when this light should be on or off and exactly what it indicates. It is a warning light and should be red. The light should come on only when the system is not charging or is discharging the battery. If all is working well, you will see the light is on when you turn on your master switch, and it will go out as soon as the engine is started and the charging system begins to work. Rotax specifies a 3-watt/12-volt light. If you are installing a voltmeter and you don't want to install a warning light, simply disregard terminal L on the rectifier-regulator.

The ignition system is shut down by grounding out the two ignition kill wires (see no. 4 on illustration 1b). On 912ULS engines produced prior to 2005, and all 912UL and 914UL engines, these two brown ignition cut-off wires have their own individual connectors. Use a shielded wire of good quality to connect these leads to your kill switches. Ground the shielding only on one end and use high-quality switches rated for at least a 250-volt/.5-amp switching load. Remember, there is a lot of voltage on shutdown.

These ignition kill wires must be properly secured to avoid vibration, or they could eventually break. If all the wires to the engine were somehow severed, the engine would continue to run. Consequently, if one of the kill switch wires becomes disconnected accidentally, that ignition will not shut down and you would have to use the choke or primer to shut the engine off. That's a handy trick to remember if your engine refuses to shut down.

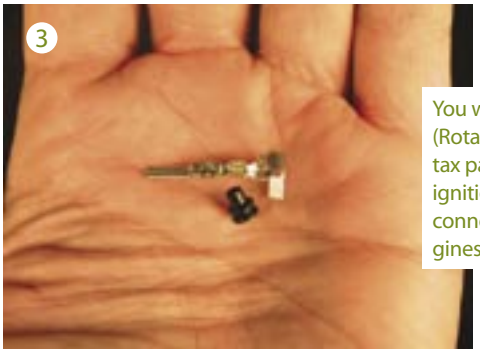
The blue and white wires with the small plastic connector go to the tachometer. 4 5



In 2005, Rotax added this improved wiring harness to the 912ULS, which is secured to the ignition modules with a new, stainless steel bracket designed to increase the life of the wires and the connectors. The two yellow wires with brass connectors are the charging wires that must be connected to the external regulator-rectifier. The blue and white wires with the white plastic connector are the tachometer wires.

The two six-pin connectors stacked one on top of the other to the left of the black ignition boxes each have one empty hole. (See arrows.) These are the two ignition shut-off connections. You will need two flat pins as shown in photo 3 (Rotax part no. 265 210) and two rubber grommets (Rotax part no. 260 130) to make this connection. These wires are to be connected to the ignition kill switches and will shut off the engine when connected to ground. Older 912ULS engines, and many current 912UL and 914 engines, will have two free brown wires outside of the larger connectors. These are also ignition cut-off wires. Be careful to secure these wires against vibration. If you leave them to flutter in the breeze, eventually they will fatigue and break.

Note the fitting protruding from the left side of the aluminum compensating tube, which runs between the two intake manifolds. A lot of customers ask what this fitting is for. It is to be connected to a manifold pressure gauge, which is only necessary if you have an in-flight adjustable prop. If you're not going to use it, seal up the opening by inserting a small sheet metal screw.



You will need two of these flat pin terminals (Rotax part no. 265 210) and grommets (Rotax part no. 260 130) to properly connect the ignition shutoff wires to the six-pin ignition connectors on 2005 and newer 912ULS engines.

This new, UMA 912 2-¼-inch tachometer has all of the appropriate markings and is easy to read.

All electric tachometers require 12-volt power to work. On this tach, the white and black wires are connected to the two blue/yellow and white/yellow tach output wires from the engine. The black wire is also connected to ground, and the red wire is connected to +12V.

912 Ring Mount

If you are going to install a 912 ring mount, make sure you add shims between the mount and the engine to fill any gap that might exist when the mount is at its natural dimension. Do not pull the mount together with the bolts; this will stress the ring mount and could cause cracks to develop later. The shims are available in two thicknesses: Rotax part no. 927 952 for the 5-mm one, and part no. 927 953 for the 1-mm washer/shim.

Have four of each of these shims on hand for this procedure, even though you may not need all of them. When installing a ring mount, you will also need to temporarily disconnect and lift the magneto end of the ignition modules/coil set. If your engine is equipped with 80-degree bent sockets in the lower two positions of the water pump housing, only removal of the lower hoses is necessary to install the ring mount. If your engine is equipped with the 45-degree sockets in the lower two water pump positions, then you will have to remove the water pump housing and replace these sockets—the procedure for which is outlined below—or they will interfere with the mount. 6

Cooling System Tips

Most airframe manufacturers are still using a 50-to-50 mix of distilled water and antifreeze as coolant. Some manufacturers require Evans NPG+ Waterless coolant. Check with your airframe manufacturer to see which one they recommend. (See "Keeping Cool" in the January 2005 issue of this magazine for more information on coolant.)

Provided your maximum cylinder head temperature does not exceed 248°F when using the 1.2 bar pressure cap, you can still use the 50-to-50 conventional coolant and water mix. If you are using such a mix, make certain the coolant is silica free and mixed only with distilled water. Cheaper coolant can contain silica, which causes premature water pump seal failure. 7 8

If you wish to rotate an aluminum socket to a different position, you must first completely remove the socket, clean the threads, apply fresh green Loctite 648, and reinstall the fitting, stopping at the correct angle as the threads begin to tighten. Here are a few hints on the best way to accomplish this.

Carefully heat the socket to about 180°F with a propane torch to release the Loctite as you attempt to remove it. Apply rotational pressure as you heat it so you will know instantly when it is warm enough (loosens) to avoid overheating the part. Be warned, you will probably destroy the socket as you remove it, so have new sockets on hand before you begin this process. If you attempt to rotate a socket, even a little, it will leak unless you follow the procedure outlined above and completely remove and reinstall it. In the engine shop at Lockwood Aviation Repair, we use an 18-by-1 mm tap to clean the threads before attempting to screw in a new socket with fresh Loctite. 9

If you don't have a tap, then carefully use a scribe to clear the threads of residual green Loctite before attempting to install a new fitting. Once the threads are completely clean, apply a film of green Loctite 648 to the threaded portion of the socket and screw it in, taking special care not to cross the fine threads. The Loctite will seal the threads, even if the socket is not completely tight, so if the socket snugs up before you reach the angle you want, don't force it. Simply back the socket out until you hit the correct angle. The green Loctite will cure quickly in the absence of oxygen; even so, my technicians prefer to allow it to cure over night before filling the cooling system. 10

If you are going to reposition or replace a fitting on the water pump housing, you will first have to remove the water pump housing from the engine. Use the procedure outlined above to remove and install the socket. Purchase a spare gasket, no. 9 on the illustration (Rotax part no. 850 981), and a copper washer, no. 16 on the illustration (Rotax part no. 230 415). Also pay special attention to put the only stainless bolt, no. 17 on the illustration, back into the correct hole. Torque the water pump bolts to 90 inch/pounds. 11

Shims may be required to fill any gaps between the ring mount and the engine to avoid stressing the mount.

The new 912 water pump intake fitting can be placed in six different positions to accommodate different installations. Older engines have four positions from which to choose.

The aluminum sockets used to connect to the external rubber cooling hoses are available in three different angles to accommodate different installations. They are 45-degree, 80-degree, and straight. The straight fitting is only available though Lockwood Aviation Supply.

This 18-by-1 mm tap is expensive, but it works best for removing residual hardened green Loctite from the threads before screwing in a new socket.

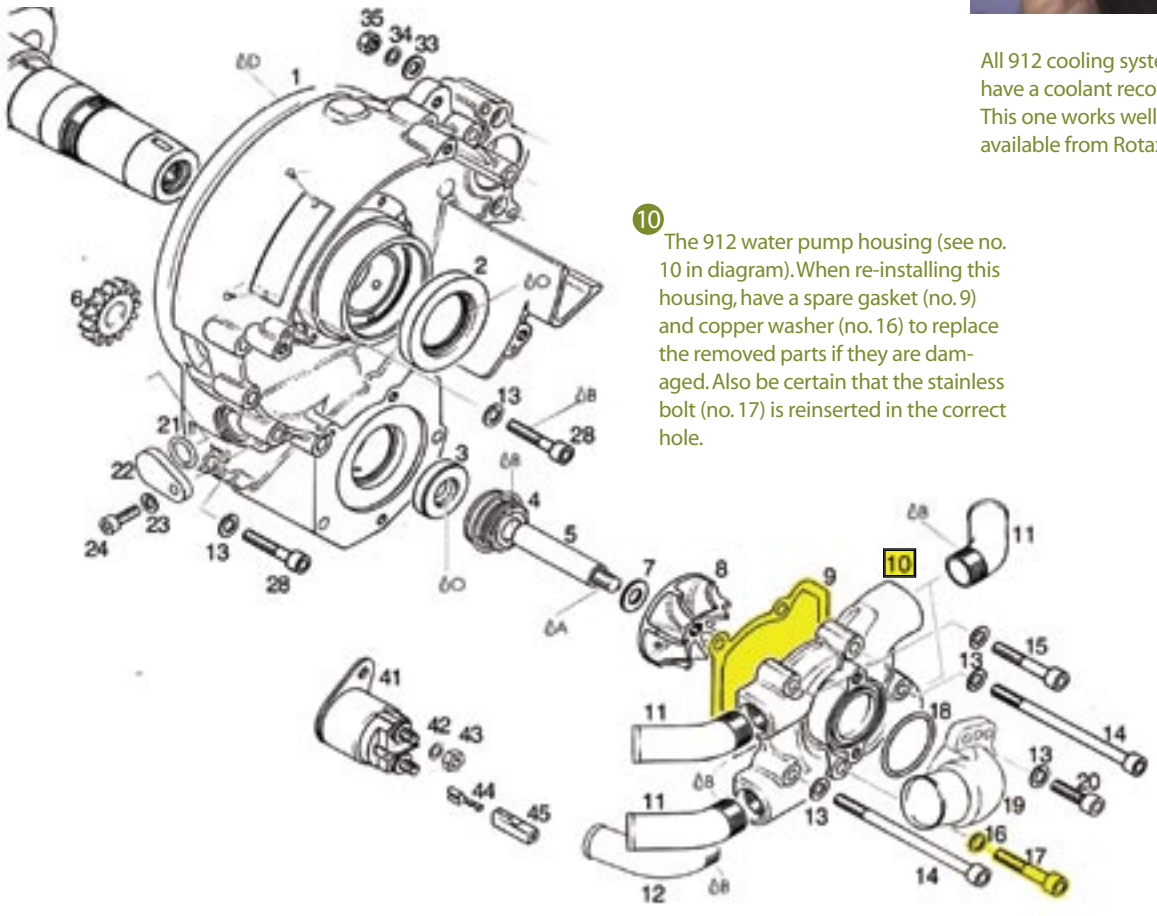
On the first start-up of a new installation, it is not enough to top off the coolant in the recovery bottle. After each flight, you must continue checking the black aluminum distribution tank, which is fitted with a pressure cap, until it remains completely full. Allow the engine to cool before attempting to open the pressure cap, or you may be burned. It's best to check this container when the engine has completely cooled to ambient temperature. Top this tank off with the same coolant mix used in the engine. Once all the air is out of the system, removing the pressure cap on a cool engine will reveal a full distribution tank. Then you need only to add coolant to the recovery bottle. The coolant level in the plastic recovery bottle should remain fairly consistent when checked at the same engine temperature. If the recovery bottle continues to require topping off, you have a leak.

Once you have a good engine installation, follow up by keeping accurate and complete logbook records of all engine maintenance. You will find a maintenance schedule in the Rotax 912 series Line Maintenance Manual.

If you are not familiar with the flight characteristics of your aircraft, get a good checkout prior to making your first flight, otherwise it will be difficult to monitor important engine parameters such as oil temperature, oil pressure, and cylinder head temperature while trying to figure out how to fly the airplane. Keep your first flight brief and make a thorough visual inspection of the engine after shut down. Look carefully for any signs of fluid leaks and top off the coolant once the engine has cooled. Tractor installations will need to be uncowled to make a proper inspection.

Beyond that, fly safely and have fun!

11 All 912 cooling systems should have a coolant recovery bottle. This one works well and is available from Rotax.



10 The 912 water pump housing (see no. 10 in diagram). When re-installing this housing, have a spare gasket (no. 9) and copper washer (no. 16) to replace the removed parts if they are damaged. Also be certain that the stainless bolt (no. 17) is reinserted in the correct hole.

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.