

Phillip Lockwood

Getting Started on the Right... Horsepower!

Tips and tricks for installing the Rotax 582 engine

Rotax introduced the two-stroke 582 engine in 1990 as a replacement for the single-ignition 532. A modern, dual-electronic capacitor-discharge ignition (CDI) system replaced the old mechanical breaker-point ignition. The 582's larger displacement provided a flatter and more propeller-friendly torque curve, and oil injection became available.

Early in 2000, the current model 99 (blue head) 582 engine was introduced in the United States, offering further refinements. Two of its most significant improvements were the standard thermostatically controlled, bypass cooling system and the durable ceramic cross shaft/water pump seals.

Twenty years of experience with these popular liquid-cooled, two-cycle aircraft engines has taught me a few lessons, the best of which I'll pass along.

First, a good installation is absolutely essential to engine reliability. Without it, you are in trouble from the start.

Keeping a Cool Head

The Rotax Operator's Manual calls for a minimum coolant temperature of 150°F and a maximum of 175°F; however, many installations run successfully with a maximum temperature of 180°F, so that is where most operators place their upper limit redline. In cold weather, the thermostat on the model 99 keeps the coolant at about 140°F, which also seems to be acceptable.

Radiator placement has a tremendous effect on the radiator size needed; pusher-mounted engines typically



Kerry Yunk of Lockwood Aviation Repair checks the gap on a sparkplug.

require much larger radiators than tractor-mounted engines.

Horizontally mounted radiators positioned above or below the fuselage are low-drag, cosmetically appealing installations. But when the radiator is mounted ahead of the propeller on pusher

aircraft, there's minimal cooling while the aircraft is on the ground. A large aluminum radiator is normally used in this setup; when combined with long coolant hoses it produces an increased coolant volume. This greater quantity of coolant works like a buffer, taking

longer to heat up and usually providing adequate time to taxi for takeoff. However, care must be taken not to overheat the engine during extended ground runs on hot days.

Most pushers *cannot* be operated continuously through the entire one-hour break-in sequence without overheating. This requires the break-in to be divided into segments, allowing the engine to cool between runs. If the water temperature approaches 180°F and does not look like it's about to stabilize, it's time to reduce power to idle and shut down the engine.

Do not allow the engine to overheat. Pointing the aircraft directly into the wind while running on the ground will improve engine cooling.

Another trick to keep a pusher engine with a belly-mounted radiator cool while performing the initial one-hour break-in is to run water from a garden hose over the exterior of the radiator. Only a small volume of cool tap water is required, but be careful not to allow water to be drawn up into the propeller or blade damage will likely occur.

If you're going to use this technique, it's best to do the break-in on grass or over a drainage grid so that puddles don't form in front of the propeller. Make sure the garden hose cannot be drawn into the spinning prop.

Rotax offers a self-contained, dual-radiator cooling system that works well on tractor engines, but it can run hot on slower flying pushers. The Rotax system is easy to install and uses a relatively small quantity of coolant, which keeps the total engine package light, and reduces the possibility of shock cooling, which can cause cold seizures on older model 90 582 engines.

Use a 50/50 mix of antifreeze and distilled water in your radiator. Distilled water can be purchased at any grocery store in gallon containers and will help guard against internal corrosion that can occur when using tap water. Avoid mixing the coolant at more than 50 percent unless you live at the North Pole, and never mix richer than the coolant manufacturer recommends. Too much antifreeze in the system will cause partial jelling of the solution.

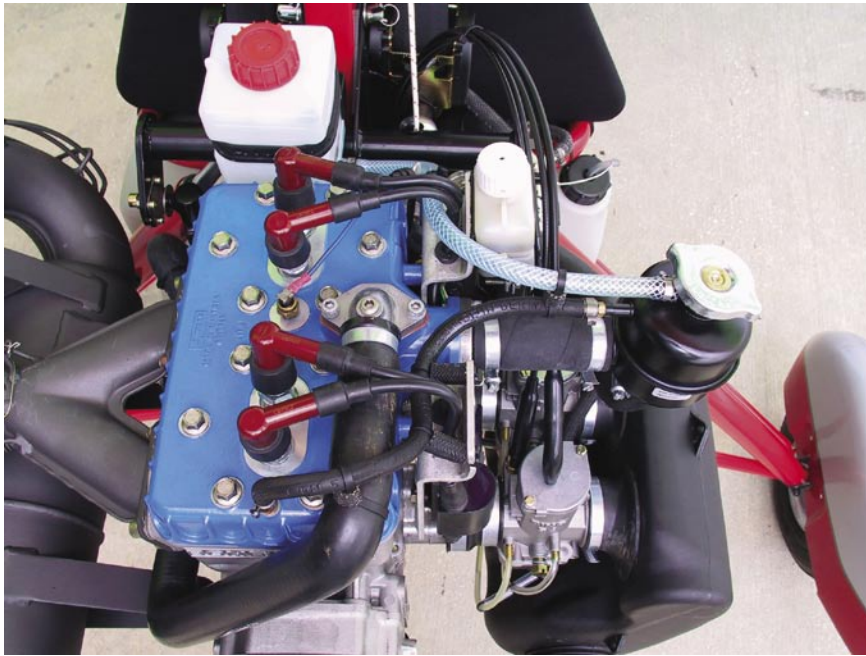
This 582-equipped Powrachute powered parachute is fitted with a large radiator because its pusher configuration combined with its low forward speeds requires it for cooling while taxiing. Note the high-mounted oil-injection tank assuring oil will gravity-feed to the oil-injection pump at all flight attitudes.



This Air Creation 582 GTE trike has a large aluminum radiator mounted beneath the airframe for a cosmetically appealing and effective installation.

The Rotax dual radiator mounts on any Rotax gearbox and makes cooling an uncowed engine easy.





582 Installations With the Spark Plugs Mounted Down

When mounting a 582 engine with the spark plugs down, the water pump must be fitted with a vent line, as shown in the accompanying drawing and illustration (Figure 1). The same vent line is fitted to the higher end of the cylinder head on an installation with the spark plugs upright and connects to the expansion tank where air can be safely vented. In either case, the expansion tank or the filler cap on the radiator must be the highest point in the cooling system.

If your engine is mounted with the spark plugs down, spend some extra time rocking your aircraft back and forth and squeezing the cooling hoses to remove air from the system before the first start-up. Top off the cooling system several times before allowing the engine to warm up. Always shut the engine off before removing the pressure cap, and do not remove the pressure cap when the engine is hot!

All 582 engines are fitted with a vent screw that can be used to remove air from the oil-filled compartment in the center of the crankcase after refilling it with oil. The two oil lines that connect this compartment to the cross-shaft oil reservoir must be modified for the inverted installation.

Correct routing of these two oil lines can be seen on page 13-2 of the Rotax two-stroke engine installation manual. You can see this vent screw just above the water pump in the photo on the opposite page, a 582 engine mounted inverted on a Drifter. This cavity is commonly called the cross-shaft oil reservoir because it lubricates the cross shaft, which operates the water pump and the rotary intake valve.

This shaft is gear driven off the crankshaft and relies on a bath of two-stroke oil to cool and lubricate it. Two-stroke oil is used in this compartment because some seepage past the center crankshaft seals is anticipated. This oil is then burned with the rest of the fuel/oil mix traveling through the crankcase. Tip the airframe so that the exhaust side of the engine is higher than the intake side to better vent this oil cavity. When

Note the vent line from the cylinder head to the expansion tank and from the expansion tank pressure cap relief fitting to the white overflow bottle with the red cap. The black expansion tank should be the highest point in the cooling system. The small white tank between the two is the cross shaft oil reservoir, which is filled with two-stroke oil. The cross shaft drives the water pump and the rotary intake valve. The water temp sender should be mounted in the middle of the one-piece head.

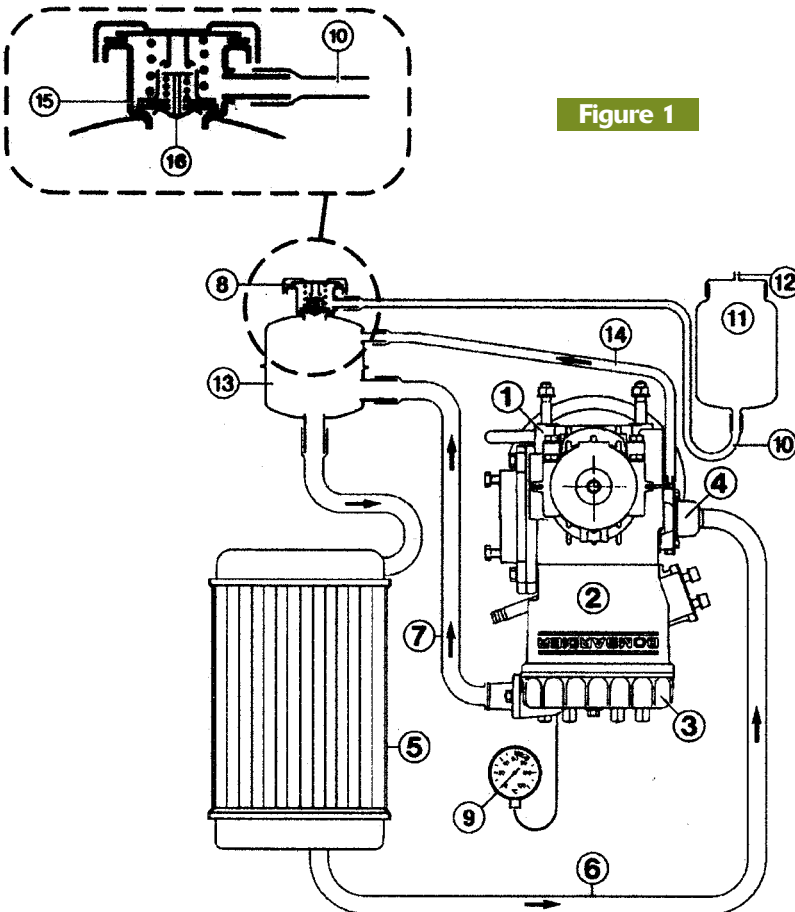


Figure 1

you first remove the screw, air will come out. Replace the screw and tighten it after a stream of oil appears. Repeat this process each time this compartment is drained to avoid seizure of the cross shaft. This procedure is only required on installations with the spark plugs mounted downward.

Exhaust System Basics

Two-stroke exhaust systems can last 1,000 hours or be destroyed in less than 100, depending on the installation and maintenance. Mounting the exhaust system directly to the engine offers the longest life; however, that's not possible on all airframe designs.

When using the recommended exhaust springs (No. 938-790) to connect the exhaust system ball joints, the distance between the hooks from the inside of one hook to the inside of the other should be 2.9 inches. This will provide the correct spring tension. Make sure the ball joints are free of dents and burrs and fit together properly. Coat

When a 582 is mounted with the spark plugs down, the water pump must be vented to the expansion tank.

the inside contacting surface of the ball joints, conservatively, with high-temperature nickel anti-seize lubricant. Don't use too much or you will have a mess, and don't get the lubricant on any fabric you want to keep clean.

The anti-seize lubricant will help keep the ball joints free, which is essential to avoid cracking. The exhaust springs must be secured with a cable or .041-inch stainless safety wire. Keep the safety wire or cable used to secure the springs a little loose so it doesn't impede the movement of the joint. Adding a bead of high temperature RTV silicone along the springs will help absorb harmonic vibration and increase spring life.

Always use new exhaust manifold gaskets when bolting the exhaust manifold to the cylinders, and make sure both surfaces are clean. Torque the



exhaust manifold bolts to 195 inch-pounds. Re-torque them after the first hour of operation and again after about 10 hours. This action must be performed when the engine is cool.

Rotax offers three different exhaust configurations, designed to work well with the 582, that can accommodate almost any aircraft. Two-stroke engines



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T-51 MUSTANG

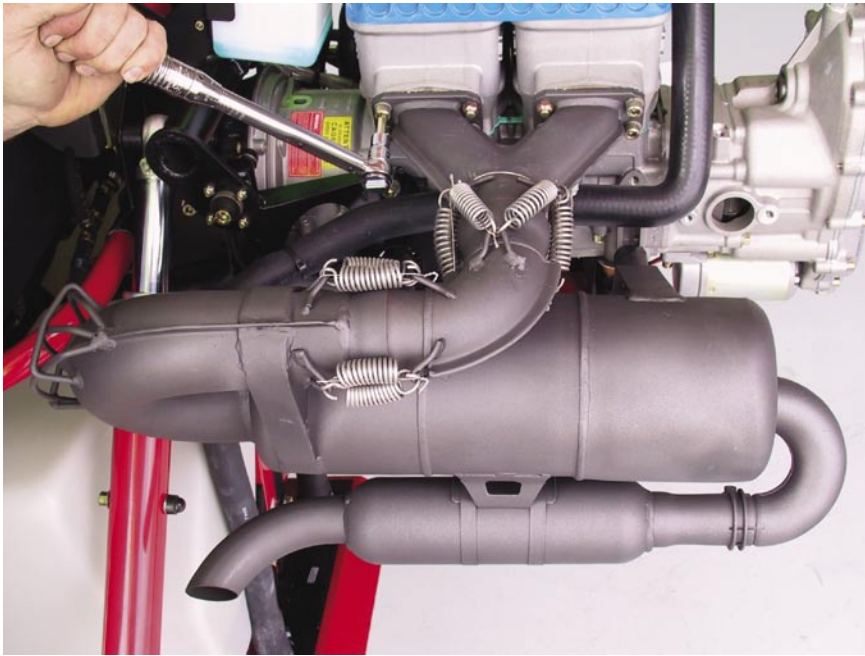
Technical Data
 Gross Weight 1232 lb
 Limit Load +6/-4g's
 Empty Weight 750 lb
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 Stal Speed 39 mph
 Climb Rate 1200 fpm
 Take Off Run 300 ft
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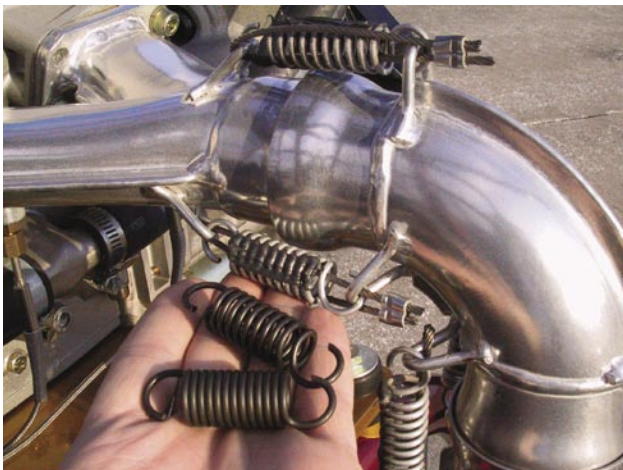
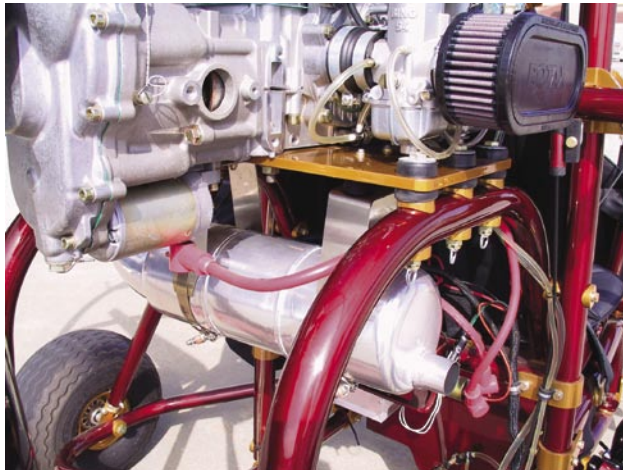
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The preferred method for mounting the exhaust is directly to the engine so that it moves with the engine, reducing metal fatigue. This engine is fitted with an optional Rotax after-muffler kit that helps to reduce noise with almost no negative effect on performance. Torque the exhaust manifold bolts to 195 inch-pounds during installation and again after the first hour of operation once the engine has cooled to ambient temperature.

This Powrachute powered parachute exhaust is mounted to the powerplant portion of the engine mount, which has the same positive effect as mounting it directly to the engine. Mufflers that are mounted to the airframe must flex with each pulse of the engine, increasing the likelihood of premature cracking.



This 582 exhaust ball joint has been coated with a baked-on ceramic finish that looks sharp and resists rust. Rotax makes a short and a long exhaust spring. Only the 582 uses the longer spring; all other Rotax engines use the short spring.

are very particular about their exhaust systems. Modifications can be tricky and often have a negative effect on the mid-range torque curve, and they can destabilize the exhaust gas temperatures increasing the risk of an engine seizure. If you must make modifications to your exhaust system, consult an authorized Rotax service center for advice.

A well-balanced propeller will also increase the life of your exhaust system as well as reducing overall fatigue on the airframe. The best way to make sure your propeller is balanced is with a dynamic balance. During this procedure, an accelerometer and an optical pickup are mounted on the engine. While the engine is running, the readings from these instruments are sent to a computer that compares the location of the spinning propeller with any vibration. This information lets the mechanic know where to place weight and how much weight to add to balance the propeller. The blades, hub, and prop shaft are all balanced together, and the results can be significant.

Currently, there are two Rotax Service Centers in North America that offer this service—Lockwood Aviation Repair, Sebring, Florida (863/655-6229), and Rotech Research, Vernon, British Columbia (250/260-6299).

Oil Injection

The oil injection system on the 582 works well, provided it is set up properly. The oil-injection pump must be gravity fed, which requires the oil injection tank to be mounted well above the pump inlet. Keep in mind the maximum climb and descent angles the aircraft could experience. Also consider g-loading and the effects of vibration. Remember, if the tank falls off in flight, you are going to have a bad day.

The Rotax oil-injection tank comes with a vented filler cap. If you are using a tank with a non-vented cap, the tank will have to be vented by some other method.

Briefly remove the venting screw, marked A in the photo on page 40, to bleed any air that might be in the supply line before you start your engine for the first time. Use a three-way cable

splitter to throttle both carburetors and the oil-injection pump together using one throttle cable. Adjust the oil-injection pump control arm so that the two lines indicated by arrow B, in the photo on page 40, align at idle.

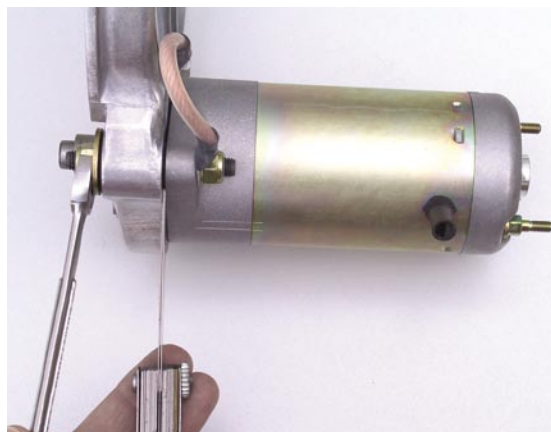
It is a good idea to mix your first 6 gallons of fuel with a 100-to-1 fuel/oil ratio and then add pure fuel once you are sure the oil injection system is consuming oil. (See "To Inject or Not to Inject" on page 46 of the September 2004 EAA Sport Pilot magazine.)

Carburetors

Adjust the throttle linkage at the top of each carburetor so the two slides are even with each other. At full throttle the slides should disappear from sight when looking in from the air filter side of the carburetor. At idle, the slides should hit the idle stops in the carburetors and not hang on the throttle cables.

Set the engine idle speed using the large, hexagonal, idle-adjustment screw

If you are installing a magneto-side electric starter, check the gap between the starter motor and the cast aluminum housing to which it is mounted. The gap should be 0.040 inch and can be adjusted as shown above. The starter motor is mounted in rubber. If you make the common mistake of tightening the mounting bolts until the gap is gone, the casting and possibly your engine crankcase will crack.



centered on the left side of each carburetor next to the primer fitting. Make sure both carburetors are set the same by comparing the slide position at idle. Do not allow the engine to idle below 2000 rpm or the resulting roughness and shaking will cause the carburetors to malfunction, possibly causing the engine to quit. It's best if you can set the idle between 2400 and 2800 rpm where the engine will smooth out. A smooth

idle will extend the life of your gearbox and exhaust.

Monitor the performance of your carburetors with a dual exhaust gas temperature gauge (EGT), and never allow the mixture to lean above 1,200°F or you may seize your engine.

Engines mounted on pusher aircraft must use the special K&N air filter (model SP2703), which can easily be safety-wired in place. Extra care must

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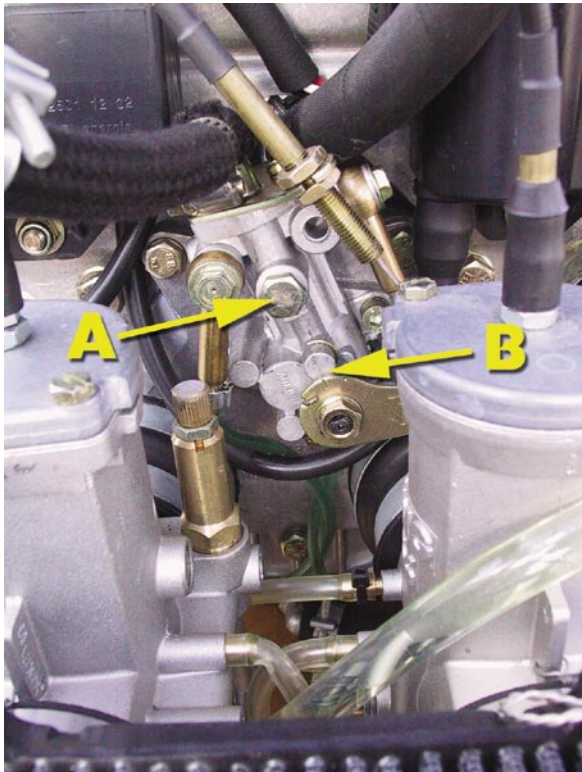
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The 582 oil-injection pump: (A) venting screw; (B) these marks must align at idle.

Fuel line filters. Be sure the filter has at least a 0.15 mm metal mesh screen.



be taken when setting up a pusher-mounted engine to make certain nothing can fall off the engine and get into the propeller. Don't leave any tools behind either.

The Gearbox

The Rotax two-stroke gearboxes will run about one hour without gear oil. Other owners have unintentionally verified this fact, so there is no need for you to sacrifice your gearbox in the name of science. *Never run your engine with a dry gearbox.* Instead, fill your gearbox to the lower of the two level checking screws located on the side of the gearbox. Rotax recommends API GL5 or GL6 85W140 gear oil. Many engine owners have had good experience with Pennzoil 80W140 gear lube oil.

Safety-wire the two screws on the side of the gearbox, the bottom drain plug, and the vented filler plug on top of the gearbox. (See "Two-Stroke Gearbox Basics" on page 48 of the August 2004 *EAA Sport Pilot*.)

Fuel Filters and Line

Use a filter with a metal mesh screen of 0.15 mm similar to the ones pictured here. Avoid using paper filters. Installing a gascolator between the fuel tank and

fuel pump is a good idea. A well-made gascolator will remove both debris and water from your fuel.


Avoid using inexpensive translucent blue or clear fuel line in areas where it is difficult to inspect or replace. This type of line generally needs to be replaced once a year. Contact an authorized Rotax Service Center for other fuel line recommendations.

Add a protective sleeve over the fuel and pulse line wherever it comes in contact with any part of the engine, and make sure all of your connections are secure. The pulse line, which supplies the standard Mikuni fuel pump with its required pulses of air power from the crankcase, should be less than 20

inches long. Most Rotax Service Centers will stock a special, more rigid fuel line designed for use as a pulse line.

If you are equipping your aircraft with an electrical system, consider installing a suitable auxiliary electric fuel pump. Contact an authorized Rotax Service Center for specific fuel pump recommendations.

For More Information

Rotax has published an installation manual that is full of valuable information and can be found online at www.rotax-owner.com or www.rotax-aircraft-engines.com. Get off to a good start with your engine and you'll reap the rewards throughout the engine's life. 

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, onehalfvvguy@worldnet.att.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.