

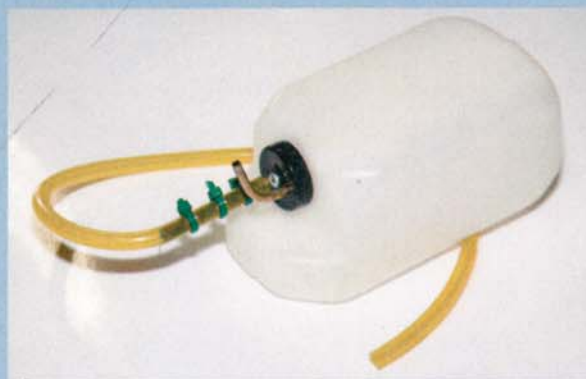
HOW TO MAKE A SMOKE MUFFLER

A quick-and-easy money-saving DIY technique



BY GERRY YARRISH

A great way to add excitement to your RC flights is to add a smoke system. Do a loop or a roll and then add a dense, low-hanging smoke trail and you have an airshow! You can save some bucks by modifying your stock muffler instead of buying a commercial one. Then you can take that money and apply it to the cost of the smoke pump and required hardware. Here's how I did it with my Zenoah G-20-powered Hangar 9 quarter-scale J-3 Piper Cub.



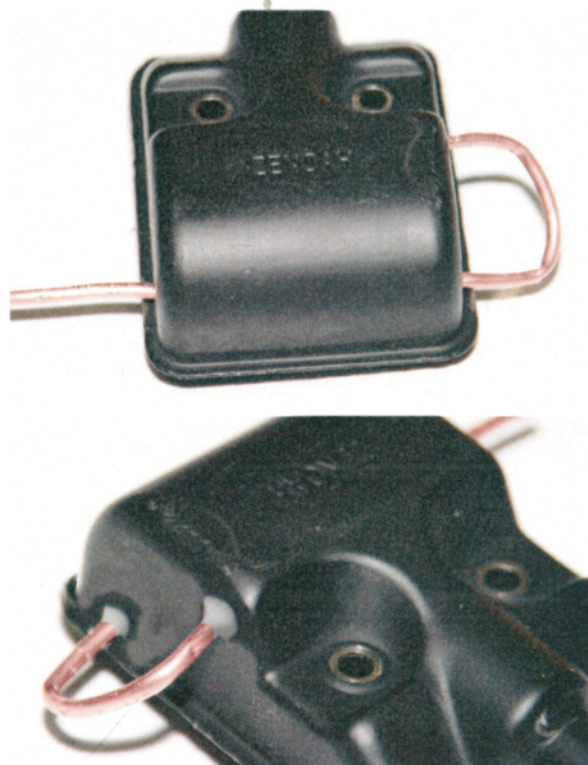
Step 1: Here's the stock muffler removed from the engine and cleaned up with some MEK solvent to really degrease it. I used a new single-edged razor blade to remove the old exhaust gasket. Here you can see the new one I will add after the muffler has been modified.

Step 2: The plumbing needed is a mix of Tygon gasoline fuel line and heat-resistant silicon tubing that holds up well to the heat of the muffler. To modify the muffler all we need is a large brass tube that fits into the main exhaust pipe to be used as a baffle tube, and a thin brass or copper for the oil preheat and injection tube. I use Du-Bro and K&S tools to cleanly bend the tubing. For the smoke oil tank, I use a Sullivan 10-ounce tank set up with a standard two-tube setup. Be sure to use tie wraps to secure your tubing.

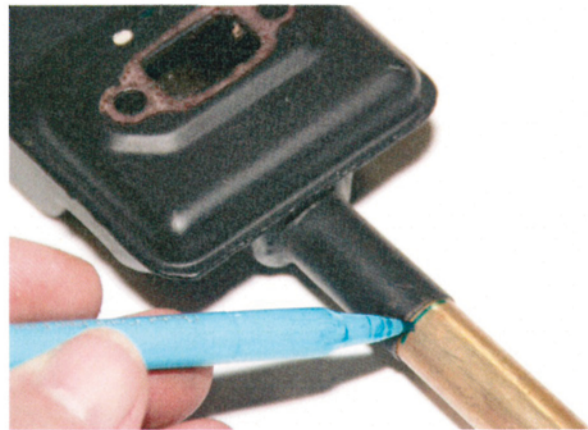


Step 3: The first thing to do is to cut, bend and prepare the end of the Injector tube. To make a fine atomized spray of oil into the muffler, I use a cutter to snip the end of the copper tube. This seals the end and shapes it so it resembles a fish tail. I then use a thin cut-off disk with my Dremel to nick the middle of the fish tail. This produces an opening about half the area of the stock tubing end. The tube is then bent so it's long enough to enter the side of the muffler, pass through to the other side, and then bend 180 degrees to re-enter the muffler.

Step 4: Drill three holes in the side of the muffler. Depending on your muffler and engine installation, these holes have to be custom laid out. On mine, the single entry hole is on the muffler's aft side, and the two others are on the front side. Drill the holes slightly larger than your injection tube's diameter. For my 1/8-inch O.D. oil-injection tube I drilled 1/8-inch holes then used a rat-tail file to enlarge the holes slightly. Now use a drum-grinding bit with your Dremel and grind away the black finish on the muffler. This will provide a clean surface for the metal epoxy to stick to.



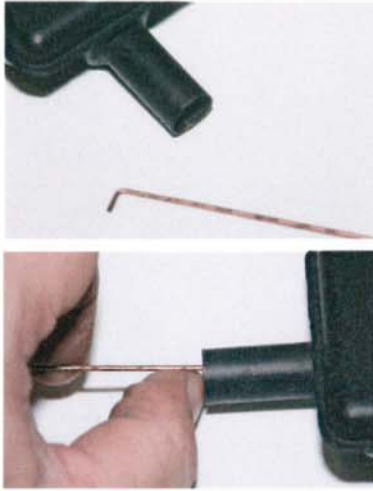
Step 5: Here you see the injection tube installed and ready to be sealed with JB Weld metal epoxy. Be sure to clean the injection tube as well as the surface of the muffler. Build up fillets around the tubes/holes areas. Smooth the fillets with a wet finger and then set aside for 24 hours to fully cure.



Step 6: To provide a baffle tube, a large brass tube is slipped in to fit into the muffler and the fit should be snug. The tube is longer than the internal tube already in the muffler. Slip it into place, bottom it out and then mark the length. Use a K&S Tubing cutter and cut it to length.



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Step 7: To get the length of the internal tube, I used a bent piece of wire or welding rod. Slide it into the muffler, slip it over the end of the internal tube and with your thumbnail, use the wire as a depth gauge and transfer the length to the brass tube. The area at the end of the brass tube will be the baffle section and will need to have several holes drilled into it! Drill several $\frac{1}{8}$ to $\frac{3}{16}$ -inch holes in the end and then sand smooth. Slip the baffle tube into the muffler until it bottoms out and is flush with the exhaust pipe. Drill a hole and secure the brass tube in place with a pan-head sheet metal screw.



SMOKE ON!

Having a smoke system doesn't mean very much without something to "burn!" A new smoke oil from Robart Manufacturing is Liquid Sky. This new oil is available in 5- and 1-gallon quantities and it provides excellent, long-lasting smoke. Liquid Sky is used by pros and Joes for turbine as well as piston engine-equipped aircraft and is foam safe. Liquid Sky makes very dense smoke and there is also a subtle Root Beer scent to help mask that automotive gasoline smell you get from a great day at the flying field!

THE THREE STEPS FOR GOOD SMOKE ARE:

Heat equals smoke! Whenever possible, preheat your smoke fluid before it is injected into your muffler. Using a simple pressure fitting to inject the fluid is not a good setup.

Regulate your smoke fluid flow. Too much smoke oil is worse than too little. Excessive oil cools the muffler, which reduces the amount of smoke it generates and shortens smoke-on time by burning up the fluid faster than is needed.

Do not switch the smoke pump on when you engine is at low throttle or at idle. You can cause the engine to drown on the unburned oil which increases back pressure. A good idea is to mix the smoke switch with your throttle channel and set the on position to anything over half throttle.



Step 8: To route your smoke lines into the cabin area, drill a hole in the firewall and slide a stiff wire into the hole. Guide the wire until it enters the cabin and then attach your smoke line to the wire and pull it into place. At the end of the smoke line, install a 1-inch-long piece of glow fuel silicon tubing with a short length of aluminum tubing. Silicon holds up to heat much better than Tygon gas tubing. Connect the silicon tubing to the oil injection tube and bolt the muffler back into place on the engine. Reinstall the engine cowl. Notice that I had to grind away a little bit of the cowl to clear the injection tube.



Step 9: Now it's time to install the plumbing, tank, pump and a way to meter the smoke oil flow. I made a removable tray to secure all the hardware. Velcro holds the tray in place, double-sided tape attaches the tank to the tray, and some foam padding protects the pump and motor from vibration.

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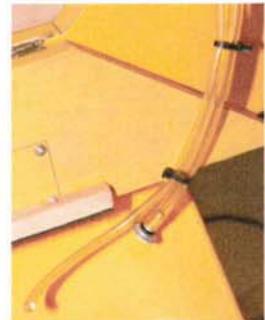
Step 10: I use a fuel filters for a clean oil flow, a check valve to prevent muffler pressure from pushing oil back into the pump tubing, and most importantly, a remote needle valve assembly to regulate the oil flow. If you don't meter the flow properly, the oil can cool off the muffler and reduce the amount of smoke it generates. This is much better than using a clamp on the oil tubing. I used a needle-valve assembly from an old O.S. .61 engine. It works great!



Step 11: Smoke oil pumps are available from several sources. Two that I have used are the TME (requires 12V battery) and the Don Harris pump, which can be powered simply by plugging it into the receiver. There are others as well from Sullivan and from Slimline Products. A bit of advice here is before you install the pumps and attach the plumbing, be sure to check which pump fitting is the "IN" and which is the "OUT." This will save a lot of grief if you were to go ahead and install everything and then find out something is hooked up backwards.



Step 12: Here's the finished installation in my Hangar 9 Piper Cub. Notice that I use a lot of cable ties to keep the plumbing neat and prevent it from moving around. I used a T-fitting to fill and empty the smoke tank and placed it between the pump and the tank. Note the positions of the needle valve assembly and the check valve. Be sure to place the needle valve in a convenient place to make it easy to adjust. In this installation, I run the vent tube out along the filler line. This automatically allows the overflow to spill out away from the model while filling the tank. For tighter installation, use separate Fuel Dots to fill and empty your smoke system.



Step 13: Check out the smoke density! This is what it looks like with the oil flow almost completely shut down (only one turn open). This setting gives a lot of "smoke-on time" and the 10-ounce tank lasts more than 10 minutes. The system works great and when you switch the smoke off, it takes about 5 to 7 seconds for the smoke to stop completely.

