

\$250 SMOKE SYSTEM

Vince Homer

(Photos by V Homer except as noted)



Photo by Jim Thorton

We've all craned our neck upward to watch airshow performers draw elegant smoke trails across the sky and secretly said, "That looks like fun!" Maybe it's time to draw some of your own smoke trails with the \$250 smoke system.



Photo by Jim Thorton

I looked at commercial smoke systems and they seemed beyond what I could justify. After looking through some of my priceless "junk" collection, I realized one could build a perfectly adequate smoke system within a reasonable budget. For those of you that don't have a lifetime collection of "useful" treasures a complete materials list is provided with suppliers and item costs.

A little research told me that one needed between 0.4 gpm and 1.0 gpm of smoke fluid pumping capacity. The system detailed here pumps about 0.4 – 0.5 gpm producing decent smoke trails for my Onex.

The smoke oil tank is a one gallon plastic gasoline container with a few modifications. A larger smoke oil tank may be used if your aircraft has the C.G. tolerance and space for it. A fluid pick-up “Flop” tube was added as well as a one-way check valve to allow air to enter to replace the fluid being pumped out while preventing spillage in other-than-positive “G” maneuvers. To simplify and modularize the unit, using E6000 I glued the smoke fluid pump, solenoid valve and the check valve directly onto the container. The purpose of the normally closed solenoid valve is to prevent smoke fluid from siphoning out through the nozzles. I discovered this need when a puddle began to appear under my exhaust stacks. The battery is a standard 1000 mah, 4s lithium battery from the radio control world. The battery powers both the pump and the solenoid valve.



Inside end of the “Flop” tube
The tube is glued into a 1/4” hole
through the top of the fuel can.
The inside end is weighted with (4)
1/4” stainless nuts

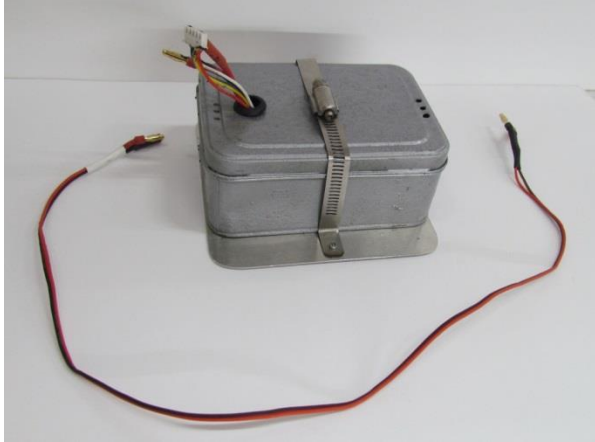


Lithium Battery, 1000 mah, 4s
Held in place with a large elastic
band for easy removal for charging
(First version)



Assembled smoke tank with pump and solenoid valve

At the suggestion of smarter people the lithium battery was wrapped in fiberglass cloth and relocated to its own metal box away from the smoke tank. The hazard is very low considering the short duty cycle, relatively low power draw and the battery is taken out for charging, but just to be safe, it's now in a metal box.



Decorative tin battery box with battery wrapped in fiberglass cloth.

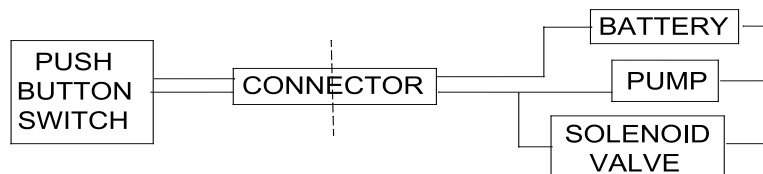


Smoke system installed in airplane.

Using automotive connectors the system is wired with a push-to-talk momentary switch that controls both the solenoid and the pump. The switch is mounted in a small plastic block with Velcro straps that wrap around the control stick grip.



The basic wiring diagram for the system is shown below:



High temperature plastic tubing is used throughout the system to get the smoke fluid from the container to the injection nozzles. A quick disconnect fitting after the solenoid valve allows the tank assembly to be removed from the aircraft for battery charging and refilling with smoke oil.

I also installed a cockpit shut-off valve to keep the tubing contents from draining when the tank was removed. (After I added the solenoid valve and the quick disconnect with

a built in shut-off making the cockpit valve is probably redundant. I'll leave that up to you.)

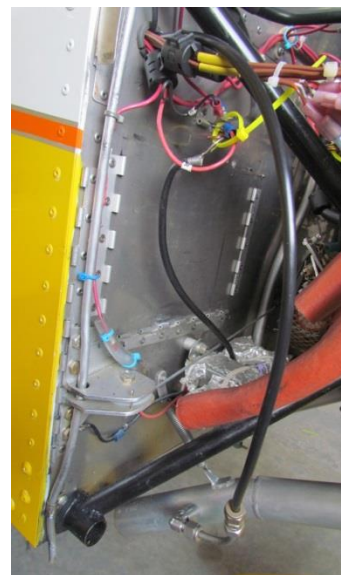
The injection nozzles were purchased from McMaster-Carr and sized to flow a total of 0.5 gpm. You can install one larger nozzle in one stack, or if you have two stacks, one nozzle in each as I did on my Jabiru 3300. The nozzles may be installed in one of at least two ways; they can be installed directly through the exhaust stack with band clamps and a stainless sleeve or by inserting a tube up the stack through the outlet opening. The latter method causes a slight exhaust flow restriction but does allow installation without the need for any hole drilling in the exhaust system. In either case, the nozzle(s) should be at least 12 inches from the end of the exhaust stack(s).

Other than the through the pipe nozzle installation, the goal of this project was to not require any permanent modifications to your aircraft. One does need to route the smoke fluid tube through the firewall, but I suspect most will be able to find an existing firewall penetration that will accommodate it.

Once through the firewall the smoke fluid tube tees into two tubes, one for each exhaust pipe or goes directly to a single exhaust pipe.



Nozzle flow with pump running

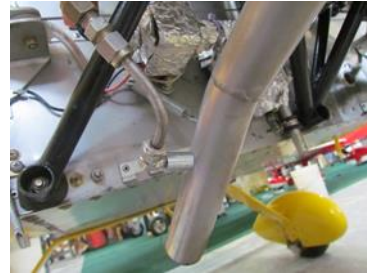


Early single exhaust pipe installation
(Nozzle too close to the exhaust pipe end)

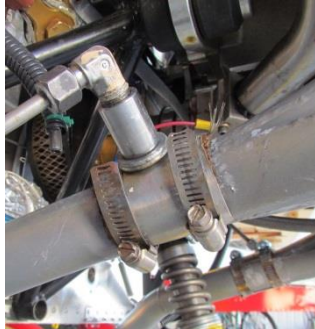
The fittings are held on with worm drive clamps and a .060 stainless cover sheet shown in this photo. A generous layer of muffler cement is applied under the stainless sleeve to seal against exhaust leakage.



Left exhaust w/o clamps & sleeve.



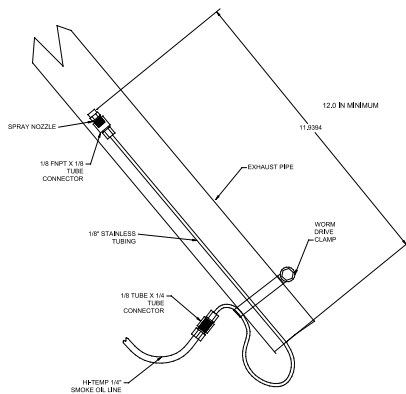
Right exhaust w/o clamps & sleeve.



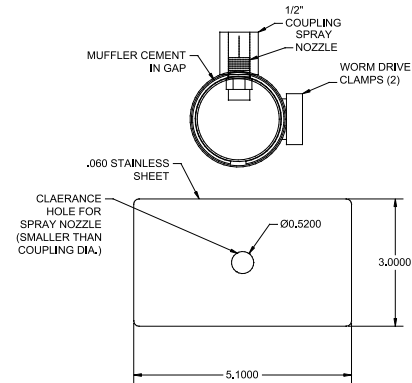
With sleeves in place.



Exhaust installation nozzle/tubing breakdown.



"Up-the-pipe" nozzle/tubing schematic.



Thru-the-pipe nozzle sleeve schematic.



Commercial smoke fluids.



Dual exhaust pipe installation tee.



Smoke system in place.



System secured.






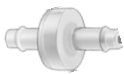

























Making Smoke

APPENDIXES A

(This may be more appropriately supplied through the Kitplanes web site)

The parts breakdown is:

COMPONENT	SUPPLIER	COST	ITEM	VERSION
12 VDC Pump	Electronic Goldmine #G21177	5.95		All
Pump adapter fittings	Electronic Goldmine #G22237	4.95		All
1 Gal.(or more) Plastic Fuel container	Common NAPA, etc item	15.00		All
Push-to-talk switch	Electronic Goldmine #G1801B	4.99 (10)		All
4s 1000 mah Lithium battery	Hobby Shop	15.00		All
1/8" Poly check valve	McMaster-Carr 47245K11	5.84		All
1/4" RC model fuel tube (1')	Hobby Shop	2.00		All
Goop or E6000 adhesive	Hardware store	6.00		All
1/4 tube to tube connector (2)	McMaster-Carr 52215K537	13.18		All
Quick disconnect plug w/shutoff	McMaster-Carr 51545K76	15.11		All
Quick disconnect socket w/shutoff	McMaster-Carr 51545K23	13.31		All
Push-to-connect fittings (2) 1/4 fnpt x 1/4 tube	McMaster-Carr 1901K29	12.44		All
1/4" stainless coupling (1-2)	McMaster-Carr 4464K212	2.57 - 5.14		Thru Exh
16 ga stainless sheet (2" x 6")	McMaster-Carr 8983K115	4.75		Thru Exh
Permatex 80335 Sealer, 3 oz	Hardware or auto parts store	5.00		Thru Exh

Stainless worm drive coupling (2 – 4)	McMaster-Carr 5388K28	8.34		Thru Exh
Push-to connect fitting ¼ MNPT X ¼ Tube	McMaster-Carr #1901K22	10.00		Thru Exh
Steel Compression fitting (2) ¼ tube x ¼ fnpt	McMater-Carr 52215K425	12.48		Thru Exh
Push-to connect fitting ¼ MNPT Tee	McMaster-Carr #1901K14	6.60		All
¼ OD stainless tube (1 ft)	McMaster-Carr 8989K91	1.91		Thru Exh
1/8 OD stainless tube (3 ft)	McMaster-Carr 8989K121	7.73		Exh Insert
Misting nozzles ¼ npt (2)	McMaster-Carr 32885K143	22.68		Thru Exh
Misting nozzle 1/8 npt (2)	McMaster-Carr 32885K131	20.22		Exh Insert
1/8 fnpt x 1/8 tube compression fitting (2)	McMaster-Carr 52215K611	29.30		Exh Insert
1/8 mnpt x ¼ tube compression fitting (2)	McMaster-Carr 51875K61	6.14		Exh Insert
Shut-off valve (Optional)	McMaster-Carr 4796k55	16.11		All
¼" Hi-temp tubing (10 ft)	McMaster-Carr 52355K57	25.00		All
Electrical connector	Ebay-Hopkins 47965 2-Pole Flat Extension	2.16		All
Electrical wire (10 ft)	McMaster-Carr 8233T11	6.46		All
Solenoid valve (Normally closed)	Ebay-HFS 12 VDC Solenoid Valve Fuels N/C - ¼" FNPT	9.00		All
Metal box	Walmart	2.00		All
Fiberglass cloth	Ebay	5.00		All
	Total (Thru the exhaust)	\$232.00		
	Total (Exhaust insert tubes)	\$270.00		

