Cockpit Ventilation Comments
By Bud Yerly

It is a shame that for all of the writing, suggesting and excellent input from the hundreds of Europa Owners we have never settled on the ideal vent location or system. Much was scattered about the Matronics Europa site as well as The Europa Club.

To summarize from my wilting memory are some notes on heating and ventilation:
Basic rules on ventilation:

1. What goes in must go out so consider exit air as well as entrance air.
2. The small cockpit of the Europa requires the builder to assure the vents and airflow are placed and directed wisely to achieve the desired airflow and comfort level as well as clearing cockpit legs, wiring and instrument panels.
3. Heating ducting can be done from radiators moved into the cockpit, ducting off the oil and glycol coolers or simply wearing proper clothing or heated suits such as used by motorcycle riders in winter.
4. Vents that are fixed or open always tend to not work year round. In winter I find all ducts/vents closed is comfortable, but all of them open for a summer stroll around the pattern is absolutely necessary. Direction and adjustment of the flow is necessary.
5. Always consider any cockpit intrusion from the outside the cockpit with caution to prevent engine exhaust fumes, water leaking and engine compartment fire from gaining access to the cockpit.

Finally, for those waiting until the plane is finished to fly to try to feel out whether ventilation is necessary a warning. The Europa is all composite not unlike a thermos bottle. The cockpit is insulated and topped with a greenhouse of glass allowing UV rays to quickly bake what is inside. Today, LP Aero has produced a UV resistant Lexan that is superb, but alas the task of changing out the cockpit windscreen and door glass is not an inviting proposition. However, I have flown in aircraft using this new technology and find it very comfortable, but the cockpit is still a place that needs ventilation for proper pilot comfort.

The instrument panel module is also all fiberglass and venting of the panel and keeping avionics cool within operating limits is essential. Although I do not direct air directly into the panel from outside, I find that small fans in the top and a few openings in the bottom or avionics cooling fans required by some manufacturers are essential for proper avionics cooling and long operational life. Some ideas follow:

NACA Ducts supplied from Europa or similar:

A NACA duct is an excellent air source but has a few limitations on installation in the Europa directly to the cockpit.

1. The duct must be installed so that the inlet to the skin is as thin as is practical. If one simply installs the duct over a 1/8 inch skin with only the inlet area cut out, the large lip that is left will build a bubble of air and will not work properly. Normally the inlet lip should be no more than 1/16 inch or 2 mm maximum.

2. The lip must be strong enough for sanding/finishing over so normally solid glass is best of about 3 layers of glass. Anything over 1/8 inch decreases efficiency.
3. The XS cowl NACA example is actually quite good in its design and function. Whereas the Jabiru attempt is just awful as examples. The sides of the isentropic curve must be flat and have sharp edges as well as the lip must be as thin as practical.

4. The NACA duct used for ventilation has interior issues as well. It can be quite long and interior clearance, trim and finish becomes a problem. One must know the position will clear knees, legs, panels, wires and such so much thought and planning are necessary.

5. Exterior location must not permit exhaust fumes from entering the cockpit. As a rule I have found that placing a cockpit NACA must be done above the extended chord line of the wing as a short exhaust stack on a 914 or 912S from the XS cowl will exit the pipe, travel slightly up the side of the aircraft and just over the leading edge unless the pipe is over 8 inches long. A typical NACA used in the Euorpa kit was installed at the wing chord line and this position allows exhaust to enter the cockpit during climb and slow flight.

6. A NACA duct installed over the top of the cockpit is water intrusion during flight in rain, and on the ground assures filling the cockpit with water during rains without a cockpit cover.

Typical aftermarket NACA cockpit / cowl duct shown.

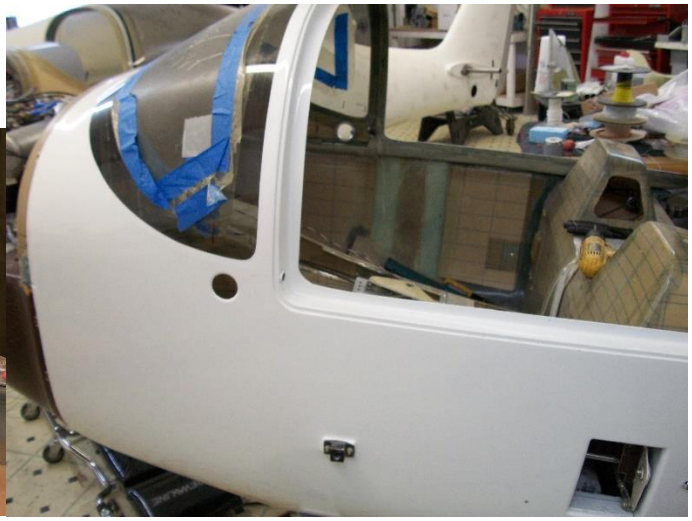
This type duct requires an inlet diffuser/shutoff to operate in all climates and is quite obtrusive into the cockpit. High quality eyeball vents are costly and plastic ones are cheap but do not seal tightly.

The Ultimate Ventilator rotating vent:

1. The vent closes nearly water tight if mounted vertically.
2. The vent is adjustable and can be directed easily.
3. I found it must be mounted fairly high (above the cockpit bond line) to direct air to ones upper torso.
4. It is very easy to install but like the NACA must be mounted to the outer skin to work properly.
5. It can be mounted to the windscreen side for operation even though the screen is some 3 mm thick. The lip protrudes just enough to keep it effective.
6. Flying in the rain is surprisingly dry but only if the knob is rotated to slightly deflect the water back and away. If it is 90 degrees to the relative wind, it will spatter some water into the cockpit during flight operations.
7. Size matters and the rotating style vent must stick out into the airstream at least ½ inch and be at least 2 inches, or near that, in diameter to be effective. I've tried the one inch variety and they were a waste of time and money. Bigger is better
8. The original Ultimate Ventilators are out of production, but alternatives are available.

Exterior and interior view of the windscreen mount is below:

Below is locating the Ultimate Ventilator below the windscreen.



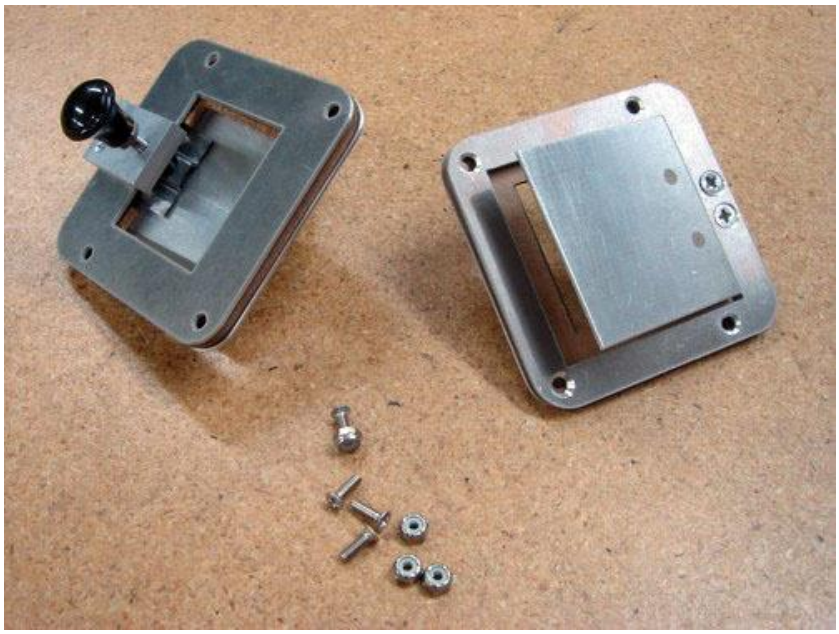
Plastic vents designed to be installed in the door/windscreen or side:

The rotating angle vent works similar to the Ultimate Vent above, but are fixed and the air inlet is somewhat small. They are better than nothing though. They come in a cup style and angular vent style.

1. The install is similar to any circular vent but the entrance hole is smaller than ideal.
2. The cup style tend to be cheap and fail at an alarming rate. They do work but some designs are difficult to set in flight. They can be used as a exhaust as well but never seal closed.

Door style inlets:

1. This scoop type door requires some clearance and ducting to be carefully considered. They are more drag producing than the NACA style or the rotating “ultimate” type but scoop considerable air.
2. Water intrusion becomes a problem as with any opening in the cockpit and when flying in the rain water intrusion is assured. The Piper ones shown can seal well with a bit of a rubber seal sold separately. They can be fitted to the glass as well as built into the structure.
3. These scoops tend to be draggy, but they are better than baking in the cockpit.



Some notes on long distant ducts mounted in the vertical tail and ducted to the cockpit:

1. Ducting mean losses in air flow and pressure. Choose wisely on the type hose used to enter the cockpit. I've even fabricated smooth glass ducting and found losses quite high.
2. It is convenient to install the ducting to the overhead and blow down on the pilot/pax.
3. Vents directed at the pilots neck and back from behind can be quite uncomfortable at high altitude. It is best to direct flow to the face and upper torso in my opinion.
4. A great deal of airspeed is necessary to overcome losses in the ducting so for ground operations an additional fan in line may be necessary.
5. Long ducting from the tail can trap water in the tubing creating mold. Plan a water vent hole.

The access door in the plexiglass door window:

1. Many certified aircraft have a small plexi' door fitted with a hinge in the pilots and or passenger door to allow some ventilation. In flight the suction of the air makes opening difficult.
2. Ground venting is poor due to lack of flow. But less of a three hands operation for ground ops while holding the door partially open on hot days.
3. The vent/door is very handy for yelling clear prop in rain or winter when one prefers the door closed. It is also excellent for emptying ones water bottle to allow a container to relieve himself.
4. In flight I find them not very good cockpit vents as they tend to be very loud and somewhat obtrusive to the line of sight. The hinge can be quite close to arms when reaching about the cockpit and the rivets/screws and hinge can cut or scrape my prized passenger.

Heaters:
Heat to the cockpit is necessary for those in northern environments. Many have written on their heating choices from heated motorcycle suits, many clothing layers, relying on the oil tank to warm your wife's feet.

I have installed many of the oil/glycol cooler scoop inlets into the cockpit, and they work when flying in shorts during the summer at high altitude. But for me, in sub zero flying, the Rotax just does not put out enough heat and flow to allow a shirt sleeved environment.

A recent bonus of computer cooling has provided a number of very good cooling fans and even radiators/heat exchangers which may be possible to use. The 160F degree coolant in sub zero weather could be piped to the cockpit to a small heat exchanger and fan for severe cold environments. I choose not to experiment in this area as size and location in fitting such a device is a matter of aircraft, owner and type aircraft. One example is shown below:

Heater Core and Fan:
Clyxgs Water Cooling Radiator, 8 Pipe Aluminum Heat Exchanger Radiator with Fan for PC CPU Computer Water Cool System DC12V 80mm 4.1'' x 3.1'' x 1.5''(L*W*H). Wt. 8 oz $20 Amazon Typically rated to only about 1 bar. So testing is required.

Outflow Requirements:
Finally, do not forget to exhaust the incoming air out of the cockpit. The draw through the cockpit is very important. I have simply cut a bit of the door seal out of the back of the door near the strut trough to allow the low pressure air above the fuselage to draw out of the cockpit air. It works. Rain does not enter and air flows out rather nicely. Others have made flaps to draw out cockpit air. That can work as well as anything. I have also put in reverse NACA ducts as well as a manufactured flap into the fuel access holes in the belly to aid drawing air. They all can work. I just don't like putting any exit on top of the aircraft as rain can get into the aircraft as well as small birds.

Some are concerned about the flap tube holes in the rear. This is an area where two things can happen. The air from the lower side of the flap will travel up to the upper (low pressure side of the wing) and some of that air enters the tunnel through the flight control hole. Normally I see this as an exit in my particular aircraft but in some it is an air pressure source depending on gap size. I believe the problem actually exists due to the wing gap seal. (See below.)

One area where air can come into even a trigear with a sealed belly is the wing root fairing. Any leaks in the gap between the wing and fuselage allows high pressure air to hit the spar and enter through the cockpit spar hole making for quite a rush of air through the tunnel. Seal this small gap area or one may find his well engineered cockpit vents not working well.

The mono wheel of course is a leaky hole in the belly that can be a huge source of pressure coming through the tunnel gear, brake and throttle holes. Because of nearby exhaust gasses, this is an area of concern. Any seal of the gear of course interferes with the gear retraction so much thought and time must be dedicated to sealing this area.

Best Regards to all as this is an area of constant irritation for some and no issue for others. We all hate when our well thought out plans are thwarted. Don't give up. No plan survives first contact with the enemy and no cockpit ventilation plan does either without some tweaking. In experimentation, it is as Dirty Harry said :"How lucky do you feel Punk". Let's hope you get it right the first time, or second, or…. As the old adage says:

If you haven't put it together and taken it apart at least 5 times, you are doing it wrong.