**Greg Norman wrote:**

*There's a lot of canards out there that see a lot of moisture and certainly if you fly to RR and OSH. Anyone experienced with a dry cabin can tell me what canopy and nose gear gaskets do you use? I look on the net at it looks like the small U-shaped neoprene edge strip may do the trick but I'd like to hear it from someone who's been around the wet block. A brand, photo, website, etc. would be greatly appreciated.”*

**Ugolini responded:**

*“1. The best way to seal the cabin is to engineer a solution. I have zero air leaks and no water ever in the cabin of my Long-EZ. I used to have lots of leaks until I realized exactly why it was happening. It took a lot of trial and error and different solutions to finally come up with a system that works.*

*The cause of air leaks is low cabin pressures, NOT air being blown into the openings.  It doesn’t matter what types of seals you use, your cabin will leak air from the tininess of openings because you are sucking air/water into the cabin. Try measuring cabin pressure (with an airspeed indicator) to prove it to yourself if this is happening. Originally before mods, my cabin pressure measured -60 mph.*

*2. The only way to seal out leaks is to raise your cabin pressure. A small external scoop (ram air) to slightly pressurize the cabin keeps leaks/water from being sucked into the cabin. My cabin now has a +40 mph pressure which is the reason why I am no longer plagued with air leaks.*

*Seals.*

*The ‘Long-EZ V seal” from ACS is perfect for the job. The problem is the canopy gap is inconsistent around the perimeter of the cabin. Adding additional seals, modeling clay, etc doesn’t fix the cause of the problem just the symptoms. It just means you are adapting the seals to the gaps, not adapting the gaps to the seal.*

*A seal really needs a consistent gap to properly seal without taking a set from being overly crushed or making the canopy hard to close. Its easy to do. Use a Luan plywood which is (.200 in thick) and cut a strip 1/4” wide. Hot glue the strip to the longeron, cover with box tape, and micro the canopy, close the canopy, let cure. You will have molded a consistent recess in the canopy for the seal to live. This will allow the seal to be properly crushed (.175”) without being smashed flat. The gap never changes, so closing/ locking the canopy pressure never changes.*

*My gaps used to be from 1/8” to 3/8” before molding a channel for the seals. I guess the canopy as it post cures and moves, changing the gap between the longeron and the canopy. After molding my seal area, I have not had to adjust my cabin in years and the canopy easily locks close.*

*Cabin Pressure.*

*This is the most important consideration. Think about it, low cabin pressures means air/water will be sucked into the cabin from every little crack or crevice in the plane. The differential pressure means there is no way to stop air from finding a way in and raising cabin pressures is the only way to stop the smaller leaks. I have a 1.75” round ram air inlet (2.4 sq in) to raise the cabin pressure which seems to be a bit to large as I have to restrict the airflow into the cabin. Overall, the inlet raises my cabin pressure to +40 mph which eliminates all my air/water leaks.*

*Three years ago, I rebuilt the nose of my Long-EZ around the concept of Ram air/ ram heat which was a lot of work. It proved the proof I need to be confident recommending this approach to others.*

*For just simply modifying a flying plane it is quite a bit easier. In my cozy I cut a small opening in the side of the cabin (easier than the bottom of the plane), just forward of the rudder peddles. Then made a small scoop to attached to the side of the plane (1.75 sq in opening).*

*Be sure to install a way to close the flow of air when flying in cold weather.  A better solution is to install a heater core at the opening to allow the pressurized air to be heated up as it enters the cabin. With ram air heat, I can comfortably fly in sub-freezing temps without a jacket or gloves.*

*Another builder installed a 2 sq in ram air (with an heater core and oil pump) in the nose (on the bottom) of his cozy with an oil cooler/pump and now has exceptional heat with no air leaks. The system works.*

*I hope this helps you see what the cause is of your air leaks and options for eliminating them. Contact me privately if you wish to further discuss your question.”*

**Then Ugolini added:***“I have a 1.75” round ram air inlet (2.4 sq in) to raise the cabin pressure which seems to be a bit too large as I have to restrict the airflow into the cabin. Overall, the inlet raises my cabin pressure to +40 mph which eliminates all my air/water leaks.*

*A better solution is to install a heater core at the opening to allow the pressurized air to be heated up as it enters the cabin.*

*1) Is the air coming into the cabin through the plans exhaust heat muff not enough to pressurize the cabin?*

*As always, data is the best answer to your question.  What is your cabin pressure?  What is the driving force for the heat muff air entering the cabin?  (high pressure in the cowl or low pressure in the cabin?).*

*Before made any mods on my Long-EZ, I took lots of data over a number of years, made small changes to confirm the I was moving in the right direction, and eventually,  I removed the entire nose of my plane to implement a solution.  A bit radical I must say for the EZ but I wanted to replace the nose anyway so at the time it was just another iteration of my quest for better heat which proved to be successful.   The Cozy I am working on, a simple mod is all that is needed.*

*The simple answer is IF the cabin has a low enough pressure to draw heat from the muff, then you will leak air through the canopy seals and any other opening, winter and summer and when flying in the rain.  Positive pressure in the cabin at all times is the goal to eliminate all leaks.”*

**Ugolini was asked *“****2) Could a ram air inlet as you described be routed through the heat muff to both pressurize and heat the cabin?”*

**Ugolini answered: *“****Interesting thought but worthy of consideration.  I tried a few of ways to improve the heat output of the muff on my Long-EZ.  Increase surface area and a fan to improve airflow.  All were unsuccessful due to air leaks which overwhelmed an heat I drawing into the cabin.*

*You should take some measurements of your existing air pressure, make the mods you are interested and let the group know what you discover.   Simply take a airspeed indicator, hook one side to your static system (as a reference point).  You’ll easily see what your cabin pressure is, and when you make mods, you’ll be able to measure your results.”*

**Kent Ashton commented:**

*“I don’t fly much in rain but one way to seal against air leaks (and most water) is to make some balls out of modeling clay, put them between thin saran wrap and close the canopy on the balls.  Open the canopy and measure the thickness of the squashed balls of clay.  That shows what kind and thickness of gasket you can use.  I mostly use 1/4” window insulation foam from the home stores and build up extra thickness, where necessary, with 1/4” strips of 3M double-stick mounting tape—stick the seal on the canopy.  In some places I use the white D-shaped door/window insulation.

Experiment with some short pieces.  You want to compress the foam a bit but if you build it up too much, it will make the canopy hard to close.

I have read of guys using thin rubber hose inflated with a blood-pressure bulb.”*

**(Beagle doesn’t like oil running all the way up in an airplane, but:). In answer to a guy who was designing a oil heat exchanger up front, Ugolini added:**

*“Be sure in your design to allow a method to close off the ram air from coming into the cabin when needed.  This is important to ensure that when you start your flight on a cold day, and your oil is cold you can stop the cold air from entering the cabin.   Once the oil is hot, then you can open the door to allow heated air to come into the compartment.*

*Additionally, put a restrictor plate with holes in it (1 sq in total open area as a start) on outlet side of the heat exchanger (HE) to control the amount of air exiting the HE.  This will ensure you don’t needlessly over pressurize the cabin and allow for more heat transfer time within the HE for the incoming air.*

*The best way is to start with small holes in the restrictor plate, measure your cabin pressure and keep increasing the size of the holes until you achiever 30-40 mph positive pressure in the cabin with a airspeed indicator (connect one input of the ASI into the static system as a reference point).  A positive cabin pressure will eliminate any air/water leakage into the cabin from various openings.”*

David Orr added:

“I have been aware of these oil cooler up front ideas for over a decade and have the luxury of living in SoCal; but warm feet are the key and a pair of 12 volt electrical socks have helped me mid-winter going out of Seattle; in cold country, added electrically heated vest or seats seem to work too.  In any case, I would worry about hot oil circulating around the passengers and up to the nose in case of a leak or a crash...and we've had one guy, actually his wife, have just that, a leak all over the floor of a Velocity, resulting in a drop in oil pressure and forced landing.

When Richard Riley was alive at Berkut, he studied this and suggested you put a tap in the oil sump about 2 gallons above empty and pump the hot oil off rather than running engine pressurized oil that might completely empty the sump...lastly, some of the guys have suggested they can't keep the oil warm because opening up the nose oil cooler on a cold day operated in conjunction with a rear oil cooler and dropped the temperature way down on the oil - leaving little heat for the occupant and a cold engine.  One guy at Santa Monica added a cable operated cover over his engine side oil cooler - a little complex... However, the Berkut folks put the extra oil radiator under the rear seat with a fan on the firewall side of it - shortening the oil lines considerably...but unless you could pressurize the cabin there, I suppose that defeats the pressurization system Nick has been advocating?  I've never explored all this myself, I'm in SoCal, after all, where the girls are pretty and slim, and too many can't stay home when ordered to...”

**Kent Ashton added:**

*“Where you have it now could make access to the nose gear mechanism difficult, depending on what sort of access hatch you have over the nose. There is no reason it has to be centered. Maybe off to the side would be better but these things take lots of head-scratching.*

*However, I suggest that if you seal up the cockpit well, including places like the nose gear area, a heater is an unnecessary complication. I am pretty comfortable down to about -5°C with sunlight through the canopy, a sweater, and the plans heater to take the chill off the legs. If I added a blower to the plans heater, I’m pretty sure it would improve on that. If I flew in really cold weather I think I would try to make a larger heat duct and add a blower.*

*On a Long-EZ, I installed SAE connectors for a heated vests. I never got to use them but my buyer said they worked really well.*

*When I have flown in cold, wet conditions (which is not often), I see a problem with moisture forming inside the canopy and it would seem that an oil heater is not going to heat up fast enough to do much about that. As it is, I have to completely block off my engine oil cooler in the winter to keep the oil at the desired 180°F.*

*So you can see that I’m trying to talk you out of your idea. These are fair-weather airplanes anyway—no ice, no freezing rain. When it’s that bad, wait for better weather.”*

**More from Ugolini in Apr2021:**

 *“You are spot on Del.  The Cozy has a lower cabin pressure than the Long-EZ.  Thus, the Cozy is more efficient at moving heat from high pressure area (cowl) to lower pressure area (the cabin) than is your EZ. Your cozy cabin pressure must be especially low if you are getting Huge amounts of air leaks even with supplemental makeup air from the higher pressure cowl area.*

*For curiosity sake, you might want to actually measure your actual cabin pressure. It’s easy enough to do and would give you some valuable information.*

*Find an old airspeed indicator. Connect one side of the ASI to your static system.  You’ll quickly find that you are flying at a negative cabin pressure, which provides you with some idea of what you’re dealing with.  If you have positive pressure, you wouldn't have air leaks, your ears would pop, and you could fly at 20K feet without O2.   Seriously, from what you’re saying, the evidence tends one to think you are a very negative sort of flyer (uh, cabin pressure wise)…*

*As you make incremental improvements in the cabin sealing efforts, you will have a base line starting point to measure your success by.  This is the only way to really know if you’re making a difference with your efforts..*

*Heck its lots of fun too!  In the world of Causes and Effects data IS understanding and the more of it the better.  More data, more understanding, repeat.  Eventually you reach the “Ah, Ha!!” moment.  It’s what we all look forward!    Hum, a bit of digression?*

*Gathering data was the starting point which lead me to eventually solving the air leak and heating issue which is inherent in the design of our planes.*

*On my Long-EZ (before modifications) the cabin measured at a -55 mph @ 120 kts. Air leaks galore. If I lowered the landing light a 1/2” or so I could easily get -70 mph or  push it way out into the airstream for an unbelievable -120 mph negative pressure!  This is why in the summer we EZ flyers lower the landing light a bit for more ventilation. Just like a cowl flap.  It crates more negative cabin pressure.*

*After modification the Long-EZ with RAM air heat, it now has a +40 mph cabin pressure with the ASI, no air leaks, great heating.  It’s simple engineering.*

*That was a long winded digression to finally to answer your question,*

I am afraid if I seal it up well the heat won’t have any way to get in if the air can’t get out; I wonder?

*Just seal the heck out of your cabin.  If you seal it too well (no heat flow) lower the landing light a bit and you’ll lower the cabin pressure and heat will flow.*

*BTW, this is a tip for those with cold cabins. A lot of heat is sucked out of your legs due to the very thin glass of the wheel well.  Super cold in the winter time.  Yikes.  To reduce cabin heat loss and make your legs more comfortable, consider insulating it. That is very easy to do.*

*1.  Go to the local Pep Boys or the equivalent and pick up a Mylar bubble windshield sun visor.   It is a great insulator because it has air pockets with layer of Mylar top and bottom.  Tiny bubbles…Yay.  It is a very efficient, light weight insulator.*

*2.  Cut a paper Template that fits over your wheel well,*

*3.  Cut the Mylar to fit your template, and drape then tape the seams with AL foil tape.   Looks silvery cool.*

*I flew ‘silver snake’ for a number of years, but eventually covered the Mylar with 1 layer of bid to keep from doing tape repairs.  Since the cover is non structural it only takes minimal effort wetting the glass to make it hard.*

*A very light, quick and easy afternoon project which measurably improves cabin comfort.”*