

Always-on Pre-Heating: No longer a sin?

Last month, I wrote an article about a clever, innovative engine heater (Aerotherm) that basically turned your engine compartment into a 'small room/hangar' and gave the engine the equivalent of a 'heated hangar' by shrinking the 'hangar' down to just the engine compartment. It did this basically by sucking air out of one side of your cowl plugs, heating the air as need, and blowing it back into the other side via the other cowl plug opening. The fan ran continuously and the inline heating element turned on or off as need to keep the circulating air at the specified temperature.

Would anyone say that this is functionally different to the engine than being in a heated hangar? I can't see how. Every cubic mm of the engine is bathed in 50F air, just as if that were the temperature of the heated hangar. So most would agree that while there is a taboo against 'running a preheat 24/7' that such a taboo does not apply in THIS case, as the engine is basically in a heated hangar for all intents and purposes.

Now let's move on to a similar case, my F33A Bonanza (his name is 'Bruce', by the way...). I installed a Reiff heating system with a 200 watt 'heat pad' on the oil pan, and 50 watt heat bands around each cylinder (The Tanis is pretty much the same but heats the cylinder head via a threaded heat elements that can replace either a rocker cover screw or intake bolt fasteners). Then I cover him in a thermal blanket, in an unheated hangar. Then I leave him plugged in all winter.

When he comes in from a flight, he is 'hot and toasty' (ok, more like just 'hot') with CHTs just under 400F, oil temp well over 100F, etc. Then I plug him in, pop the oil cap, cover him in a blanket and go home. Metal is a very good heat conductor as we all know and as I'll show below with extensive measurements, the 'heat pad/bands' pretty much do the same thing to keep the engine compartment warm as does the 'mini hangar Aerotherm' described previously which is to say the entire engine compartment is thoroughly and consistently 'heat soaked'.

The heating elements on my Reiff generate local heat temperatures in the 175-190F range. Every other spot in that engine is between 100 and 150F, which is a fairly consistent and warm range of temperatures throughout the entire engine compartment. And 150F is fine for an engine. But the 'tribal knowledge' will cite the fear of dreaded condensation, so we look very specifically at that. Average daytime relative humidity for the Mohave Desert ranges from 10 percent to 30 percent, and can get as high as 50% at night. Some moist nights (even in winter) can exceed 70% humidity in Chicago, which is where I took these measurements. Ready for the "That can't be right..." data? The RH in my oil pan was a mere 10%, while the ambient RH was 70%.

A hygrometer is the fancy name for the thing that measures relative humidity (RH) and I used 2 different units to calibrate and confirm the consistency of the measurements. One of which was a digital hygrometer with a small probe on a 12" wire, that was dropped down my oil tube. As shown, the air coming out of the oil pan was 48C vs 5C ambient (118 F v 41 F), and was an amazingly low 10% RH versus the 70% ambient RH. And even the air in my exhaust tubes that lead directly into the cylinders was a low 36% vs the 70% ambient that would have otherwise been permeating up through the valves and into the cylinders.

The simple analysis is: **Moisture evaporates out of a liquid when you warm it up. By popping the oil cap and warming the oil, we are 'distilling' the water out of the oil. We are explicitly dehydrating the oil.**

Now, the effect on my engine may have been completely different if I didn't

- Pop the oil cap
- Cover the engine with a blanket

But given my conditions, it seems that my engine is as happy as it would be inside a warm hangar in the Mojave Desert – warm and dry. Actually *better* because the Mojave RH will be 10-30% RH but my crankcase is being 'evaporated' and is a mere and steady 10% RH.

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Rust will form on bare metal well below the point where condensation will form. Rust starts forming at about 50% relative humidity, and gets aggressive above 80% relative humidity. During the warmest part of the day, the RH is the lowest, and warmer air is drier air. Heating the air in your engine compartment dries out the air for pretty much the same reason that heating your house dries out the air. It's not that winter air is inherently drier than warm, it is the process of heating that changes the RH.

Now I'm really going to buck the tribal knowledge and say that my situation is BETTER than 'as needed pre heating' (e.g., 6 hrs. before flight) or possible even a heated hangar because my engine is constantly undergoing dehydration at 150F and such a temperature is certainly no enemy of the engine that spend hours on end above 250F. And I have corroboration from Aviation Consumer as cited at the end of this article.



From Prop Tip back into the engine via the crankshaft, the engine is 100F 'from the inside, out'			
Prop Blade Tip: 53F 	Mid Prop Blade: 56F 	Base of Prop Blade: 62F 	Drive Shaft: 100F
 OAT: 43F	 w/"Exhaust Plugs", RH was 36 in the exhaust pipe/valves/cylinders		"Outside" vs in "Oil Filler Tube" Temp: 5C v 48C (122F) Rel Humid: 70% v 10%
And moreover, the oil is DRY! (Relative Humidity of 10% instead of 70% ambient)			

Am I the only one who thinks this way? Apparently not. In the Reiff website cites the March 2007 issue of Aviation Consumer which ran an article on preheaters and came up with stunningly similar conclusions. Some excerpts:

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- The internal RH started at 60% and after 12 hrs. of heating it dropped to 15% and stayed there for all 7 days of the testing.
- Conclusion: These findings don't support the view that preheaters cause engine corrosion. Clearly a preheater system seems to dry the engine out rather than cause it to behave like a terrarium. And while our experiment is far from definitive.....it does seem to show that far from causing corrosion, an always-on preheater actually appears to benefit the engine.

And the Tanis website says the same thing: Do NOT cycle your heater on and off, leave it on all the time.

So while it is absolute heresy in many circles to leave your engine heater on 24/7, consider the Aerotherm 'engine compartment heated hangar' equivalent of last month's article, and the "what's the difference then with a Reiff/Tanis?" herein, and the similar and quantitative conclusion of Consumer Aviation.

A few subtle differences may explain why conventional wisdom contradicts these observations. Mostly, if you do NOT pop the oil cap to ventilate the evaporating moisture then you are in fact working to explicitly condense the moisture into water and put it right back in your crankcase – not a good thing. Also, if you are outside on a cold, windy day without a blanket then your engine may very well experience differential heating/cooling with strong temperature gradients between the highly concentrated heat sources and the rest of the engine, which is very different from the 'one big happy toaster oven' and very small temperature gradients that you get under a blanket and all sealed up.

By the way, some summary numbers of "With a blanket over the engine" and "Without", even inside an unheated (28F) hangar, using my JPI EDM for measurements:

- Oil temp was 41F degrees higher (96 v 55) with a blanket
- CHTs were also about 45F warmer with a blanket, (99'sh v 54'sh)
- In 8 hrs., temps rose about 25F without a blanket, but 65F with a blanket.
- Even my metal prop was 62F at the base of the blade, and 53F at the tip.

By the way, the cost per day turns out to be a pretty consistent 90 cents to \$1.50 per day on all 3 methods (Aerotherm, Reiff/Tanis) as they all average about 400 watts and the final cost is therefore mostly dependent on your cost of electricity.

And finally "Horse blankets". Darn cheap and perfect. The prop comes out where the horses' tail normally would and the flank covers make perfect cowl cover flaps. I bought mine shown at SSTACK.com. I bought the Dura Tech Viking Turnout Blanket X-Midweight, size 84 for about \$70 plus shipping and tax. It's perfect. And it comes in different colors. But you will have to slice off the D—rings that are normally used to cinch the insulated blanket under the horse's belly since you don't want to scratch your paint. In fact, I have 2 such blankets: one that stays in my hangar, and a 'travel' blanket that I keep in my cargo section. The travel blanket has a few extra bungee hooks to keep the cover in place even on windy days, and a clasp in front to keep the front cowl area closed. And being made for outdoors, they are water repellant and weather resistant.

If you live in areas even colder than Chicago, consider cutting the pants legs off of an old snowmobile pants or such and using them for insulated prop covers! A quick Google search for Snowmobile Pants on Clearance says you can get them below \$50 a pair (if your plane doesn't mind having last year's style ☺)

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With the “Travel Cover”



With the “Travel Cover”
(Battery Minder cord in black)



The simpler ‘just throw it on...’ hangar cover



**And the whole thing fits in a standard storage tub in
the back of the cargo compartment!**

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About the author: Henry is an ABS Ambassador and flies an F33A (“Bruce”) out of Chicago Executive (KPWK) where he is the founder of the Executive Tenants Club (www.ExecutiveTenantsClub.com), that pioneered low fuel prices for tenants and he is also the President of the Midwest Bonanza Society (www.MidwestBonanzaSociety.com), and the author of the ForeFlight handbook. You can reach him (and see his website) at Henry@N78HF.com