

Whats Cold For a Piston Aircraft Engine?

When is it too cold to start an airplane engine? And, will you damage it by starting without preheat? We've got the answers to those questions, and more.

Rick Durden January 12, 2014



A few days ago, we emerged from a polar vortex that drifted south – a textbook example of what those things do from time to time. The associated cold managed to get the media into full cry and revived all of the how cold is it? jokes. Judging from Internet aviation forums, it also got a lot of pilots concerned about starting their airplanes and raised the pertinent seasonal question as to what is cold for a piston engine. At what temperature are you risking damage to your engine if you start it without some sort of preheating?

Good news: there is definitive guidance on the subject from the engine manufacturers – Continental Service Information Letter 03-1 ([PDF](#)) and Lycoming Service Instruction 1505 ([PDF](#)). Bluntly, if you want to get the straight story on what constitutes cold for your engine, as well as what to do about it, those publications are worth study.



Continental's Letter has a headline in competition for the best American understatement award: Contains Useful Information Pertaining to Your Aircraft Engine. It goes on to set a clear standard for when preheat is required: When the engine has been exposed to a temperature of at or below 20 degrees Fahrenheit (wind chill) for two hours or more. We think the use of wind chill is overly cautious as, while moving air causes an inanimate object to cool to the ambient temperature more quickly than still air, it cannot cool the object to below ambient temperature, no matter how hard the wind is blowing.

Lycoming's Instruction states that preheating is required when the engine has dropped to a temperature of 10 degrees Fahrenheit-20 degrees for -76 engines.

So, Whats the Big Deal?

The Lycoming Service Instruction unabashedly states the risks you are facing: Improper cold weather starting can result in abnormal engine wear, reduced performance, shortened time between overhauls or failure for the engine to perform properly. We are firmly of the opinion that the or in that sentence should be and.



Continental warns, Failure to properly preheat a cold-soaked engine may result in oil congealing in the engine, oil hoses and oil cooler with subsequent loss of oil flow, possible internal damage to the engine, and subsequent engine failure.

Have they made themselves clear?

Heat

There are four generally accepted methods of getting a piston aircraft engine warmed up to a temperature at which it can be safely started and operated: 1. sticking the airplane into a heated

hanger; 2. a high-volume hot air heater (preheater); 3. an engine-mounted electric heating system; 4. spring.

Item 4 is self-explanatory-pilots sometimes find themselves where there simply isn't a method of safely heating the engine to above 20 degrees F. You may be able to start the engine, but that start could cost you a bunch of money downstream as the damage may not show up right away. Its a rental, is not an excuse.

As pilots flying in mountainous areas often have to wait for the wind or temperatures to drop before they can fly, pilots at airports without preheaters or heated hangars need to wait for the temperature to warm up.

That also applies if you have single weight oil in the engine and it's not the right viscosity for the cold temperature. Even though you may be able to preheat the engine, summer-weight oil may not provide adequate lubrication.

A heated hangar is great-it warms up the entire airplane. Continental says to allow four hours to assure congealed oil is flowing. Those who have the advantage of heated hangars recommend that the pilot have everything ready to go the moment the airplane is towed out-ideally with everyone in the airplane so the pilot can hit the starter as soon as the tug is clear. It doesn't hurt to open the windows until the engine is running and the heater putting out warm air as windows have a tendency to fog and ice over quickly otherwise.

Preheaters

Continental and Lycoming both provide guidance on the use of preheaters. Lycoming specifically disapproves the use of oil dipstick heaters because they don't distribute the heat throughout the engine. Both manufacturers are explicit in calling for careful use of the preheater to assure that all of the engine is heated-oil sump, external oil lines, cylinders, air intake, oil cooler and oil filter. Be careful not to damage non-metallic components such as seals, hoses, and drive belts.



Continental says to preheat for a minimum of 30 minutes. Lycoming says to apply heat in five to 10 minute intervals and then feel the engine to be sure that it is retaining warmth. It goes on to say that during the last five minutes, the heat should be directed to the top of the engine.

Once preheating is complete, both manufacturers call for starting the engine immediately. We agree-we've seen too many pilots finish preheating, then start setting up their iPads and plugging in the headsets over 10-15 minutes and then discover the engine won't start because it's gotten cold again. Have everything ready to go.

Engine-Mounted Heaters



Because not many owners can afford a heated hangar, we like engine-mounted preheating systems. For an in-depth review of the various systems, take a look at the April 2013 issue of [Aviation Consumer](#). Continental recommends a system that includes individual cylinder head heater thermocouples, oil sump heater and crankcase heater pad. *Aviation Consumers* review found that both the Reiff and Tanis systems worked well. Having owned three airplanes with engine-mounted

preheaters, I have found them to be handy, especially when traveling as the combination of a blanket over the cowling and a long extension cord allows preheating at almost any airport. For more remote airports, I carried a generator to run the system for four or five hours before I wanted to start.

Continental warns against running engine-mounted preheaters continuously due to concerns with corrosion. There are well-reasoned opposing views. For those who are concerned, there are a number of devices that allow remote control of the engine-mounted heater via cell phone. These were reviewed in the September 2013 issue of [Aviation Consumer](#). Owner feedback has been positive.

Starting

Both Continental and Lycoming urge immediate starting after preheating is complete. They caution the pilot to assure that the start is made at low engine RPM, not more than 1000, due to risk of cylinder damage from lack of lubrication and to assure that oil pressure comes into the acceptable range soon after start.

Pumping the throttle before or during start is not a good idea. It creates a high risk of engine fire on a cold start. Pumping the throttle more than once usually does nothing but flood the carburetor.

For a carbureted engine, the proper procedure is to use the primer to put fuel directly into the cylinders. Many operators recommend leaving the primer out and letting it fill with fuel after the last pre-start priming shot. Then, as the engine is cranking and fires, give another shot or two of prime.

Continental goes into detail regarding post start procedures in cold weather. Briefly, it calls for frequently checking oil pressure to assure that there is not congealed oil somewhere in the system that can cause engine damage-it will manifest itself by high or low oil pressure indications. Do NOT let the RPM exceed 1000 until some oil temperature is indicated. This is important-we've all seen the pilots who start the engine at 1500 or 1700 RPM; they're damaging the engine, hot or cold.

Continental says that if the oil pressure cannot be maintained above 30 psi or below 100 psi, shut down and repeat the preheat process. It also says not to close the cowl flaps during engine warm up.

Once oil temperature is indicating, the engine may be operated as high as 1700 RPM, however, it should be approached gradually to make sure oil pressure does not exceed 100 psi. The runup can be conducted. Continental recommends cycling the propeller three or four times to move cold oil out of the propeller dome. On feathering propellers, do not let the RPM drop more than 300.

Only when oil temperature exceeds 100 degrees F and oil pressure does not exceed 60 psi at 2500 RPM, is the engine sufficiently warmed to accept full rated power.

I'll add the suggestion that it's a good idea to take an absolute minimum of five seconds in going from idle to full power during a cold weather takeoff-at least 10 seconds is probably better. I've seen engines cut out with rapid throttle movement in cold weather.

Continental also recommends that the post starting procedures regarding RPM, oil pressure and oil temperature be followed on engine startups at temperatures between 20 and 40 degrees F when preheat is not used.

Winter is going to stick around in the northern hemisphere for some time-following the guidelines set out by Lycoming and Continental for the cold weather may help cut the cost of flying by making engines last longer.

Rick Durden is the author of *The Thinking Pilot's Flight Manual, or How to Survive Flying Little Airplanes and Have a Ball Doing It, Vol. I.*