Cold Weather Engine Starts-Just the FAQs Ma’am…

Tom Petry, TRCS

The October CTWG Aircrew newsletter reminded us that as winter approaches, we need to be aware that starting a cold engine can be not only difficult, but more importantly that it can result in significant engine damage—dramatically shortening the time before an expensive overhaul is needed, or even pre-disposing to engine failure.

So, from a practical perspective, what does that mean for us as, and what do we do about it?

Below is a compilation of information on the subject, presented in a “frequently asked questions” (FAQs) format. Some of the thoughts and recommendations on specific procedures represent this author’s opinions, but they do have some relevant experience behind them. Connecticut is my 5th and final CAP Wing, but several of my 31 years with the organization were in Michigan, where pre-heating was a big issue due to the two season climate (“winter” and “winter is coming”).

Why do I need to pre-heat?

The (sort of) simple answer is differential expansion. Engines have parts made of various metals and metal alloys, and those expand/contract to different degrees with temperature variations. Crankshafts, camshafts, and cylinders are typically made of steel, while the engine cases that surround them, as well as cylinder heads and pistons, are typically made of aluminum alloy. The problem is that aluminum expands/contracts with temperature changes much more (~2x) than does steel. Why does that matter? Below a certain point, and that point varies a bit with how tight the engine clearances at “normal” temperatures are to start with, there is literally no space between the crankshaft and the bearings because the case has contracted around them. That means that it’s impossible for lubricating oil (regardless of its viscosity or the pressure) to fit between them, so when starting the engine you have metal moving across metal, and that’s, well…BAD… Piston to cylinder clearance can become a problem too, although the reason is somewhat convoluted. At very cold temps, clearances are actually greater initially as the pistons will have contracted more than cylinders. However, cold pistons (aluminum) heat up quickly, while cylinders do so more slowly. Additionally cylinders are bored such that they taper toward the top. As the piston warms and expands, space between its rings and the cold cylinder can decrease to zero, again eliminating the ability of oil to provide any lubrication. More metal across metal movement, and that too is…BAD.

When do I need to pre-heat?

Opinions vary, as do CAP requirements. Some suggest pre-heating anytime temps are below freezing (32°F, 0°C) and the engine has equilibrated, e.g. is “cold-soaked”. At less than 20°F, there’s simply no room for debate—pre-heating is necessary. Several CAP wings have 60-1 supplements or policy letters that provide specific guidance. For example, NHWG makes pre-heats mandatory at temps <32°F, while OHWG does so if the A/C has been parked for more than 2 hours at temps below 20°F. CTWG does not
have a formal policy, but certainly anything less than 20°F moves pre-heating from a PIC judgment call to
a requirement.

Do I need to pre-heat if overnight temps were low, but it’s starting to warm up?

Yes! Air has a low specific heat, but it’s also a relatively poor thermal conductor, especially if it’s not
moving. While the air temperature may have climbed above 20°F, the rise in engine temperature will lag
significantly behind.

What options are available at CT airports where we typically position aircraft?

Connecticut Wing rotates aircraft between several airports, which means that while we may know our
“local” procedures, it’s common to need to begin a flight from an airport other than our home base.
Unfortunately, none of the airports where we position aircraft have “regular” hangar space. That means
that they will sit outside, exposed to the elements—including cold temperatures—rather than spending
their off-hours in a nice warm hangar, or even a cold one where electrical power is available to keep an
engine heater plugged in and a thick blanket on top of the cowling to retain the heat it provides.

Below is a table showing several airports where CTWG aircraft are commonly positioned. If scheduling
an aircraft based at one of those airports, and cold temperatures are anticipated, pilots should contact the
person shown for assistance in making pre-heat arrangements. As making contact, and subsequently the
arrangements themselves may take some time to coordinate, pilots should start that process well in
advance.

<table>
<thead>
<tr>
<th>Airport</th>
<th>Standing Pre-Heat Arrangements?</th>
<th>Free or $?</th>
<th>Contact Person</th>
<th>Contact Number (cell)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridgeport (KBDR)</td>
<td>Yes</td>
<td>$</td>
<td>CPT Charles Kruzshak</td>
<td>(203) 247-8724</td>
</tr>
<tr>
<td>Danbury (KDXR)</td>
<td>Yes</td>
<td>Free</td>
<td>MAJ Jim Vigar</td>
<td>(203) 770-8733</td>
</tr>
<tr>
<td>KDXR alternate</td>
<td></td>
<td></td>
<td>CPT John Freeman</td>
<td>(203) 558-5045</td>
</tr>
<tr>
<td>Groton (KGON)</td>
<td>Yes</td>
<td>$</td>
<td>MAJ Paul Noniewicz</td>
<td>(860) 908-1094</td>
</tr>
<tr>
<td>Hartford (KHFD)</td>
<td>Yes</td>
<td>Free</td>
<td>CPT Lenny Kimball</td>
<td>(860) 798-1963</td>
</tr>
<tr>
<td>Meriden (KMMK)</td>
<td>Yes</td>
<td>$</td>
<td>1/LT Connie Costello</td>
<td>(860) 234-7276</td>
</tr>
</tbody>
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What if no pre-existing arrangements exist, or local contacts can’t be reached?

Most FBOs can either put an A/C in a hangar, or perform a pre-heat, for a fee.
Who is responsible for engine pre-heat charges where we don’t have “no-charge” standing arrangements?

For funded missions, CAP will cover these expenses. Many FBOs will bill CAP directly. If not, do not use the Wing CC in the aircraft—those are for fuel/oil expenses only. Rather, put the charge on a personal CC, and submit for reimbursement via a CAPF108. For non-funded (B & C) missions, e.g. proficiency flights, reimbursement will be considered on a case-by-case basis. Pilots should contact COL Lloyd Sturges by phone--(860) 841-2511 (mobile) or e-mail at lrskeeter@optonline.net, to request approval. If COL Sturges can’t be reached, CPT Mark Capen--(860) 919-4501 (mobile) or markcapen@comcast.net can address the request.

What are the options to perform pre-heats? How long does it take?

Hangaring (in a heated hangar)—Far and away the best option!!! This not only pre-heats the engine, but also the instruments and avionics in the cockpit, protects surfaces from contamination, etc…. How much time is required depends on the temperature of the plane when it’s placed in the hangar, temperature of the hangar itself, etc…, but in general you should plan on a minimum of 8 hours, and overnight is better. Metals conduct heat well, but as mentioned above still air does not, so even a warm hangar is not a quick fix.

Don’t dawdle after removing an A/C from the hangar, to avoid excess heat loss (time to equilibrate is a function of temp differential, winds, etc….). Consider conducting your pre-flight, organizing the cockpit, completing crew/passenger briefs, etc… before pulling the A/C out of the hangar. These last caveats apply to the other pre-heat options discussed below as well—do what you can to minimize the time between the end of the pre-heat cycle and engine start.

Electric (resistance) heaters—These can work well if there is a convenient source of electricity. There are several variations, ranging from simple pads attached to the oil pan, to those that provide heat to all cylinders as well. Ensuring that cowl plugs are in, cowl flaps are closed, and placing some sort of blanket/engine wrap around the cowling can make a big difference. Single point (oil pan) heaters only provide adequate pre-heating if the aircraft is in a hangar (unheated) and the cowling well wrapped, such that cylinders are warmed by conduction. Depending on the outside temperature and the effectiveness of your efforts to limit heat loss, these can get an engine warm enough to safely start in as little as 2-3 hours. All CTWG aircraft have these types of heaters installed (or are slated to have them installed at their next 100hr/annual inspection), so this may be a viable option if there is a source of electricity, an appropriate extension cord, and a way to minimize heat loss by radiation.

Hot air (no, we’re not talking about Wing Staff meetings here…)—This is the most likely option if you’re getting a pre-heat from the local FBO, and many flight schools and individual aircraft owners have them as well. It can also be the most challenging to do well. Some are kerosene-fired, others propane, but all have a fan that directs hot air through ductwork of some sort directly into the engine compartment. The amount of time needed will depend a lot on the ambient temperature of course, but also on the output of the heater itself. Be very careful when using these types of heaters. Although cowlings and accessories are exposed to relatively high temps from normal engine operations, the air coming out of these heaters can be very hot, and it’s relatively easy to discolor/damage paint, melt plastic, etc… if the output is directed at a small area for an extended time. How do you know when the pre-heat is adequate with a
forced hot air system? Good question, and given all of the variables there is no set time recommendation. In short, if the areas of the engine that you are able to touch all feel warm, you should be ready to go.

Fly safe, and when flying during cold weather remember to prepare yourself for the outside environment (not what you’re expecting in the cockpit) as well.