AC 91-13C - COLD WEATHER OPERATION OF AIRCRAFT

Department of Transportation
Federal Aviation Administration

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Initiated by: AFS-806

1. PURPOSE.
This Advisory Circular provides background and guidelines relating to operation of aircraft in the colder climates where wide temperature changes may occur.

2. CANCELLATION.
Advisory Circular 91-13B dated January 17, 1978, is canceled.

3. DISCUSSION.
a. Aircraft and their components are designed to operate within certain temperature ranges. If information concerning these ranges is not readily available, operators are urged to consult the manufacturer as to the precautions to be taken in extremely cold weather operation.
b. Experience has shown that the advice of operators and mechanics permanently located in the area of operation is of great value.

4. PREPARATION OF THE AIRCRAFT FOR COLD WEATHER.
a. Insulation Against Heat Loss (Reciprocating Engines). In extremely cold temperatures all oil lines, oil pressure lines, and tanks, if possible, should be inspected for proper insulation to preclude the possibility of oil congealing. The insulation used must be fireproof material and installation should be accomplished by an experienced A and P mechanic.
b. Baffling and Winter Covers. Baffles, winter fronts, and oil cooler covers are recommended by some manufacturers. FAA approval is required for installation unless the aircraft manufacturer has provided for their approval.
c. Oil and Grease. The viscosity of the oil and grease used is very important in cold weather operation. Use only the grades of oil and grease specified by the manufacturer.
d. Oil Breather (Reciprocating Engines). The crankcase breather requires special consideration when preparing for cold weather. Frozen breather lines can create numerous problems. When crankcase vapors cool, they may condense in the breather line and subsequently freeze it closed. Special care is recommended during the preflight to assure that the breather system is free of ice. If modification of the system is necessary, be certain that it is FAA approved.
e. Hose Clamps, Hoses, Hydraulic Fittings, and Seals. An important phase of cold weather preparation is to inspect all hose lines, flexible tubing, and seals for deterioration. After replacing unserviceable components, be certain that all clamps and fittings are properly torqued to the manufacturer's cold weather specifications.
f. Cabin Heater. Many aircraft are equipped with cabin heater shrouds which enclose the muffler or portions of the exhaust system. It is imperative that a thorough inspection of the heater system be made to eliminate the possibility of carbon monoxide entering the cockpit or cabin. Each year, a number of accident investigations have revealed that carbon monoxide was a probable cause of the accident.

g. Control Cables. Because of contraction and expansion caused by temperature changes, control cables should be properly adjusted to the aircraft manufacturer's specifications.

h. Oil Pressure Controlled Propellers. Propeller control difficulties can be encountered due to congealed oil. The installation of a recirculating oil system for the propeller and feathering system has proven helpful in the extremely cold climates. Caution should be taken when intentionally feathering propellers for training purposes, to assure that the propeller is unfeathered before the oil in the system becomes congealed.

i. Care of Batteries. Both dry cell and wet cell batteries require some special consideration during cold weather.

(1) Wet cell. If the airplane must be parked outside, wet cell batteries should be kept fully charged or removed from the aircraft to prevent loss of power caused by cold temperatures and to guard against battery freezing.

(2) Dry cell. Dry cells are usually associated with aircraft in only two applications; i.e., emergency lights and/or portable radios, including emergency locator transmitters. Manufacturer recommended batteries for this type equipment are resistant to power loss by freezing.

j. Wheel Wells and Wheel Pants. During thawing conditions, mud and slush can be thrown into wheel wells during taxiing and takeoff. If it then freezes during flight, this mud and slush could create landing gear operational problems. The practice of recycling the gear after a takeoff can be used as a preventive procedure. However, the safest procedure is to avoid these surface conditions with retractable gear aircraft. It is recommended that wheel pants be removed from fixed gear aircraft to prevent the possibility of frozen substance locking the wheels or brakes.

5. OPERATION OF THE AIRCRAFT.

a. Preflight inspection. A thorough preflight inspection is extra important in temperature extremes. At extremely low temperatures, the urge to hurry the preflight of aircraft and equipment is natural, particularly when the aircraft is outside and adverse weather conditions exist. This is the very time to run the most thorough preflight inspection.

(1) Fuel contamination. Fuel contamination is always a possibility in cold weather. Modern fuel pumping facilities are generally equipped with good filtration equipment and the oil companies attempt to deliver pure fuel to your aircraft. However, even with the best fuel and precautions, if your aircraft is warm when parked with half empty tanks, cold temperatures will condense water in the tanks.

(2) Fueling facilities. Another hazard in cold climates is the danger of fueling from makeshift fueling facilities. Fuel drums or "case gas," even if refinery sealed, may contain rust and somehow contaminants may find their way into the fuel. Cases are on record of fuel being delivered in unidentified containers which was not aviation fuel. As a precaution, we suggest:

(i) Always use fuel from modern fueling facilities and fill your tanks as soon as possible after landing.

(ii) Be sure the fuel being delivered is the correct grade of aviation fuel for your engine.

(iii) If a fuel source other than (i) is used, be sure to filter the fuel as it goes into your tanks. Note: A funnel with a

chamois skin is not a filter. Once saturated, a chamois will not remove water. There are many good commercial filters available.

(iv) Special precautions and filtering are necessary with kerosene and other gas turbine fuels. Manufacturers can supply full details on handling these fuels.

(3) Aircraft fuel filters and sumps. Fuel filters and sumps (including each tank sump) should be equipped with quick drains. Sufficient fuel should be drawn off into a transparent container to see if the fuel is free of contaminants. Drain all of the fuel sumps on the aircraft, including individual tank sumps. Extra care should be taken during changes in temperature, particularly when it nears the freezing level. Ice in the tanks may turn to water as the temperature rises, and pass through the filter into the carburetor or fuel controller causing the engine to stop. During freeze-up in the fall, water can freeze in lines and filters - causing stoppage and fuel leaks.

(4) Aircraft preheat. Low temperatures may cause a change in the viscosity of engine oils, batteries may lose a high percentage of their effectiveness, and instruments may stick. Because of the above, preheat of engines as well as the cabin before starting is desirable in low temperatures. Extreme caution should be used in the preheat process to avoid fire. The following precautions are recommended: (Turbine engines use synthetic oils, therefore, (i) is also applicable for this type of equipment.)

(i) Preheat the aircraft by storing in a heated hangar, if possible.

(ii) Use only heaters that are in good condition and do not refuel the heater while it is operating.

(iii) During the heating process, do not leave the aircraft unattended and keep a fire extinguisher handy.

(iv) Do not place heat ducting so it will blow hot air directly on combustible parts of the aircraft; such as, upholstery, canvas engine covers or flexible fuel, oil, and hydraulic lines.

(v) When using a "fire pot" (salamander) for heating, it is suggested that wire mesh be inserted in the ducting between the pot and the engine to stop flaming pieces of carbon from entering the aircraft or engine compartment.

(5) Engine starts.

(i) In moderately cold weather, engines may be started without preheat. Particular care is recommended during this type of start. Oil is partially congealed and turning the engine with the starter or by hand is difficult.

(ii) There is a tendency to overprime, which washes down cylinder walls and possible scoring of the walls may result. This also results in poor compression and, consequently, causes hard starting. Aircraft fires have been started by overprime. It is good practice to have a fireguard handy during these starts.

(iii) Another cold start problem that plagues an unpreheated engine is icing over the sparkplug electrodes. When this happens, the engine only fires a few revolutions and then quits. There has been sufficient combustion to cause some water in the cylinders but insufficient combustion to heat them up. This little bit of water condenses on the sparkplug electrodes, freezes to ice, and shorts them out. The only remedy is heat. When no large heat source is available, the plugs should be removed from the engine and heated to the point where no more moisture is present.

(iv) Engines may quit during prolonged idling because sufficient heat is not produced to keep the plugs from fouling out. Engines which quit under these circumstances are frequently found to have iced-over plugs. Prolonged idling should be avoided.

(v) Turbine engines can accumulate internal ice overnight and resist rotation when starting is attempted. With any indication of locked rotor, unusual noise or low RPM, discontinue the start. The procedure here is fundamental. Always be aware that the rotors could freeze on any cold weather start and be alert enough to discontinue the start before damaging the engine. When weather forecasts include snow, ice, or sleet, engine cowl plugs for jet engine outlet openings should be installed if aircraft is to be exposed to the elements.

(6) Removal of frost, ice, and snow. All frost, ice, and snow should be removed from all airfoil and control surfaces, and around the static system sensing port. Alcohol or one of the ice removal compounds can be used or it can be melted off in a heated hangar. If it is melted off, be sure the water doesn't run into control surface hinges or crevices, and freezes when the aircraft is taken outside.

(7) Blowing snow. If an aircraft is parked in an area of blowing snow, special attention should be given to openings in the aircraft where snow can enter, freeze solid, and obstruct operations. These openings should be free of snow and ice before flight. Some of these are:

(i) Pitot tubes and static system sensing ports.

(ii) Wheel wells.

(iii) Heater intakes.

(iv) Carburetor intakes.

(v) Tailwheel area, especially where snow can freeze around elevator and rudder controls.

(vi) Fuel vents.

(8) Ski operation. The ski safety cables and shock cords should be carefully inspected. Pay particular attention to those on the front of the skis. If the front cables or shock cords should break on takeoff, the nose of the ski can fall down to a near vertical position which seriously affects the aerodynamic efficiency of the aircraft and creates a landing hazard.

(9) Fire extinguisher. Fire extinguishers should receive special winter attention. CO2 bottles should always have the proper charge. Dry powder extinguishers are highly desirable.

b. Taxiing.

(1) Since skis may not have brakes, a pilot should exercise extra caution at all times during downwind / crosswind taxiing and turning.

(2) Operations on wheels are difficult in deep snow and on packed snow or ice, braking action is generally poor.

(3) During cold weather operation, special attention should be given to avoidance of snow banks along the sides of runways; they may be frozen solid.

c. Takeoff. Takeoffs in cold weather offer some distinct advantages, but they also offer special problems. A few points to remember are:

(1) Do not overboost supercharged or turbine engines. Use the applicable power charts for the pressure altitude and ambient temperature to determine the appropriate manifold pressure or engine pressure ratio. Care should be exercised in operating normally aspirated engines. Power output increases at about one percent for each ten degrees of temperature below that of standard air. At -40 degrees F, an engine might develop ten percent more than rated power even though RPM and MP limits are not exceeded.

(2) On multiengine aircraft, it must be remembered that the critical engine out minimum control speed (Vmc) was determined at sea level with a standard day temperature. Therefore, Vmc will be higher than the published figure during a cold weather takeoff unless the power setting is adjusted to compensate for the lower density altitude.

(3) With reciprocating engines, use carburetor heat as required. In some cases, it is necessary to use heat to vaporize the fuel. Gasoline does not vaporize readily at very cold temperatures. Do not use carburetor heat in such a manner that it raises the mixture temperature to freezing or just a little below. In such cases, it may be inducing carburetor icing. An accurate mixture temperature gauge is a good investment for cold weather operation. On some occasions in extremely cold weather, it may be advisable to use carburetor heat on takeoff.

(4) If icing conditions exist, use the anti-ice and deice equipment as outlined in the Airplane Flight Manual. If the aircraft is turbine powered, use the appropriate power charts for the condition, bearing in mind that the use of bleed air will, in most cases, affect the aircraft's performance.

d. Climbout. During climbout in aircraft equipped with reciprocating engines, keep a close watch on cylinder head temperature. Due to the reduced cooling air flow which results from the installation of baffles for cold weather operation, and the possibility of temperature inversions, it is possible to overheat the engine at normal climb speeds. If the head temperature nears the critical stage, increase the airspeed or open the cowl flaps or both.

e. Enroute.

(1) Weather. Weather conditions vary considerably in cold climates. In the more remote sections of the world, weather reporting stations are generally few and far between; therefore, considerable reliance must be made on pilot reports.

(i) Snow showers and whiteouts. Snow showers are, of course, quite prevalent in colder climates. When flying into a shower, a pilot should be prepared to go on instruments since visual reference may be quickly lost. Whiteout is another hazard which has claimed as its victims some very competent pilots. This is a condition in which there are no contrasting ground features in the pilot's visibility range. Obviously the smaller the visibility range, the more chance there is of a whiteout. However, a whiteout can occur in good visibility conditions. A whiteout condition calls for an immediate shift to instrument flight; the pilot should be prepared for this both from the standpoints of training and aircraft equipment. If icing conditions are anticipated or exist, be certain that the anti-ice/deice equipment is put into operation soon enough so it may function in the manner for which it was designed; i.e., anti-ice equipment is to prevent ice formation, not to eliminate ice that has built up.

(2) Survival gear and clothing.

(i) If the country over which the flight is planned is such that a survival problem would be created in a forced landing, appropriate survival gear should be carried. Survival gear will vary with individual needs, temperature, and routes. There are many fine survival kits on the market. Some fixed-base operators offer these kits for rent. Probably the most important piece of survival gear is the clothing of the aircraft occupants. Survival clothing should be worn as much as possible or kept handy so that if the aircraft is forced down and a fire ensues, the survival clothing will not be lost.

(ii) In the event of an accident in sparsely populated areas, proper operation of your emergency locator transmitter can help the search party locate you.

(3) Skis.

(i) The installation of skis will cut cruising speed to some extent. In addition to some loss of aerodynamic efficiency, skis have other disadvantages. They require more care in operation because bare spots must be avoided to keep from wearing the bottom coating of the skis. The bottom coating must be renewed on some skis periodically. There is an antifriction tape which is very useful for this purpose. Skis equipped with antifriction coating do not freeze to the surface as do those with bare metal exposed to the snow. Another method of keeping skis from freezing to the surface is to taxi the aircraft onto poles placed across and under the skis. This prevents contact with the snow or ice for most of the length of the ski.

(ii) Extra care during takeoff and landing is also recommended. Rutted snow and ice can cause loss of control and even failure of skis or landing gear parts. Deep snow can adversely affect ski operation, causing prolonged takeoff runs. In this case, experienced operators pack a takeoff path with snow shoes or taxi back and forth until an adequately packed runway is available.

f. Let Down.

(1) Engine operation. During let down, there may be a problem of keeping the engine warm enough for high power operation if needed. It may be desirable to use more power than normal, which may require extension of gear or flaps to keep the airspeed within limits. Carburetor heat may also be necessary to help vaporize fuel and enrich the mixture. During descent, turbine powered aircraft often require that speed brakes / flaps / gear be extended to create drag. This permits adequate power to be maintained to supply bleed air for the anti-ice/deice equipment while holding the desired airspeed.

(2) Blowing snow and ice fog.

(i) Blowing snow can be a hazard on landing, and a close check should be maintained throughout the flight as to the weather at destination. If the weather pattern indicates rising winds, then blowing snow may be expected and may necessitate an alternate course of action.

(ii) Ice fog is a condition which may occur in calm wind conditions at temperatures of -25 degrees F and colder. It is most likely found close to populated areas.

(iii) Both of these conditions can form very rapidly and are commonly associated with otherwise clear enroute weather. Carefully check the forecast weather with such possibilities in mind.

g. Landing.

(1) Landing surfaces can be very treacherous in cold weather operations. Be aware of other hazards such as snow banks on the sides of the runways and poorly marked runways. Information about runway surface conditions should be obtained, but if it is not readily available, take the time to circle the airport to check for snow drifts or other obstacles before landing.

(2) Ski wheels. Ski wheel combinations are popular and very convenient; however, care must be taken to make the proper gear selection for the runway condition existing at the destination airport.

(3) Braking action may be poor. If the aircraft is equipped with reversible propellers or thrust reversers, remember that their use may reduce your forward visibility by blowing snow. Foreign object damage

can also be caused by reverse thrust at slow forward speeds on unimproved surfaces.

h. Post Flight. Here are a few items to consider after the flight:

(1) Fill the tanks with the proper grade of aviation fuel, especially if the aircraft is to be parked in a heated hanger.

(2) If the aircraft is to be left outside, install engine covers and pitot covers.

(3) If the weather forecast is for snow or "clear and colder," install wing covers if available.

(4) Control locks or tied controls are suggested if the aircraft is left outside. Tiedowns are, of course, also suggested. Advisory Circular 20-35B, Tiedown Sense, gives good advice on tiedowns. A copy of AC 20-35B can be obtained by writing to the: U.S. Department of Transportation, Publications Section (M-443. 1), Washington, D.C. 20590.

(5) The manufacturer's recommendations should be carefully followed if the engine oil is to be diluted.

(6) During reciprocating engine shutdown, a good practice is to turn off the fuel and run the carburetor dry. This lessens the fire hazard during preheat the next morning.

Note: The information in this advisory circular is not intended to replace, substitute for, or supersede official regulations or the manufacturer's instructions.

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