COLD WEATHER FLIGHT OPERATIONS

Winter is here and it is past time to think about cold weather flight operations. Winter flying in most parts of the United States can adversely affect flight operations. Poor weather conditions with fast moving fronts, strong and gusty winds, blowing and drifting snow, and icing conditions are just part of the conditions that require careful planning in order to minimize their effects. Granted, winters in the South are not usually considered severe, but cold is cold. Operation in this environment requires special winter operating procedures.

Winter flying is not particularly hazardous if you use a little extra caution and exercise good judgment in analyzing weather situations. Here are just a few things to think about before your next flight.

There are certain precautions that are significant to winter flying. Flight planning during winter months will require special knowledge in order to protect the aircraft as well as the pilot. Extra precautions should be used. Often roads that are well traveled during the summer months will be abandoned in the winter. A forced landing far from civilization may create a serious problem of survival.

You, the pilot, have complete responsibility for the ***GO or NO - GO*** decision based on the best information available. Do not let compulsion take the place of good judgment.

OPERATION OF AIRCRAFT

The thoroughness of a preflight inspection is important in temperature extremes. It is natural to hurry over the preflight of the aircraft and equipment, particularly when the aircraft is outside in the cold. However, this is the time you should do your best preflight inspection.

Fuel Contamination - Fuel contamination is always a possibility in cold climates. If your aircraft has been warm and then is parked with half empty tanks in the cold, the possibility of condensation of water in the tanks exists.

Sufficient fuel should be drawn off into a transparent container to see if the fuel is free of contaminants. Extra care should be taken during changes in temperature, particularly when it nears the freezing level. Ice may be in the tanks, which may turn to water when the temperature rises, and may filter down into the carburetor causing engine failure. During freeze-up in the fall, water can freeze in lines and filters causing stoppage. If fuel does not drain freely from sumps, this would indicate a line or sump is obstructed by sediment or ice.

Aircraft Preheat - Preheat the aircraft or if possible, hangar the aircraft overnight. Low temperatures can change the viscosity of engine oil, batteries can lose a high percentage of their effectiveness, instruments can stick, and warning lights, when "pushed to test," can stick in the pushed position. During cold weather, metal parts in the engine tighten, oil gets sticky, and electrolyte molecular motion in the battery is slowed. Heating the oil results in less friction allowing the engine to turn over more easily.

The engine block should be at least 40^0 F before attempting to start. An incredible amount of damage is done to the engine if started cold. The layer of thick cold oil coating the cylinder walls is scraped off by the piston rings as the pistons begin to move. During the few minutes it takes for the engine to start and for the combustion to heat the oil enough to provide proper lubrication, metal-to-metal contact is tearing up the engine. The different metals in the

engine have different rates of expansion and the tolerances in a cold engine are vastly different than in an engine at hangar temperature.

Extreme caution should be used in the preheat process to avoid fire. The following precautions are recommended:

- Preheat the aircraft by storing in a heated hangar, if possible.
- Use only heaters that are in good condition and do not fuel the heater while it is running.
- During the heating process, do not leave the aircraft unattended. Keep a fire extinguisher handy for the attendant.
- Do not place heat ducting so it will blow hot air directly on parts of the aircraft; such as, upholstery, canvas engine covers, flexible fuel, oil and hydraulic lines or other items that may cause fires.

Be sure to follow the manufacturer's procedures.

Engine Starts

In moderately cold weather, engines are sometimes started without preheat. Particular care is recommended during this type of start. Oil is partially congealed and turning the engines is difficult for the starter. Review your aircraft's POH for the proper cold starting procedures for the engine.

Over-priming and excessive throttle pumping are common mistakes. Overprime results in washed-down cylinder walls and possible scouring of the walls. This also results in poor compression and, consequently, harder starting. Sometimes aircraft fires have been started by overprime, when the engine fires and the exhaust system contains raw fuel. Fuel can also leak out of the carburetor and catch fire. This is difficult to detect because the fire gets sucked down the carburetor.

Don't crank the starter more than 20-30 seconds and allow several minutes between crankings to minimize wear on the starter system. Get maintenance assistance if the engine will not start after three attempts

Another cold start problem that plagues an unpreheated engine is icing over the spark plug electrodes. This happens when an 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 spark plug electrodes, freezes to ice, and shorts them out. The only remedy is heat.

Engines can 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.

After the engine starts, use of carburetor heat may assist in fuel vaporization until the engine obtains sufficient heat. Avoid high rpm settings for a few minutes and allow the engine to warm-up. Consider using cowl flaps to help the engine reach normal operating temperature sooner. In really cold weather it is hardly necessary to provide extra engine cooling with by having the cowl flaps open.

Radios - Should not be tuned prior to starting. Radios should be turned on after the aircraft electrical power is stabilized, be allowed to warm-up for a few minutes and then be tuned to the desired frequency.

Removal of Ice, Snow, and Frost. - Remove all frost, snow, and ice before attempting flight. Use a soft brush or broom to remove loose snow. It is best to place the aircraft in a heated hangar. If so, make sure the water does not run into the control surface hinges or crevices and freeze when the aircraft is taken outside. Even relatively small amounts of ice and snow can unbalance a control surface and lead to a

flutter problem, and subsequent damage to, or loss of, control surface.

This imbalance can extend to the propeller. The spinners of constant speed propellers can admit ice and snow causing significant vibration.

Alcohol or one of the ice removal compounds can be used. Caution should be used if an aircraft is taken from a heated hangar and allowed to sit outside for an extended length of time when it is snowing. The falling snow may melt on contact with the aircraft surfaces and then refreeze. It may look like freshly fallen snow but it usually will not blow away when the aircraft takes off.

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 operation. These openings should be free of snow and ice before flight. Some of these areas are as follows:

- Pitot Tubes
- Heater intakes
- Carburetor intakes
- Anti torque and elevator controls
- Main wheel and tail wheel wells, where snow can freeze around elevator and rudder controls.

Fuel Vents

Fuel tank vents should be checked before each flight. A vent plugged by ice or snow can cause engine stoppage, collapse of the tank, and possibly very expensive damage. Taxiing - A pilot should keep in mind that braking action on ice or snow is generally poor. Short turns and quick stops should be avoided. Do not taxi through small snowdrifts or snow banks along the edge of the runway. Often there is solid ice under the snow. On a hard - packed or icy surface, the aircraft will slide sideways in a crosswind and directional control is minimal particularly during taxiing and landing roll when the control surfaces are ineffective.

Don’t forget to read the POH and familiarize yourself with all of the aircraft anti- and de-icing equipment. This includes the window defogger. Cold outside temperatures combined with the humid inside temperatures can create fog and frost on the inside of the windows.

EN ROUTE

Weather conditions vary considerably in cold climates. Don't be lured into adverse weather by a good pilot report. Winter weather is often very changeable; one pilot may give a good report and five or ten minutes later VFR may not be possible.

Remember, mountain flying and bad weather don't mix. Set yourself some limits and stick to them.

Snow Showers and Whiteouts – If you find yourself in a snow shower, you may suddenly be without visibility and in IFR conditions. Snow showers will often start with light snow and build. Whiteout is the condition where there are no contrasting ground features within your visibility range. Obviously the smaller the visibility range the more chance there is of a whiteout; however, 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 standpoint of training and aircraft equipment.

Carburetor Ice - Three categories of carburetor ice are:

- Impact ice formed by impact of moist air at temperatures between 15-32°F on airscoops, throttle plates, heat valves, etc. Usually forms when visible moisture such as rain, snow, sleet, or clouds are present. Most rapid accumulation can be anticipated at 25°F.
- Fuel ice forms at and downstream from the point that fuel is introduced when the moisture content of the air freezes as a result of the cooling caused by vaporization. It generally occurs between 40-80°F, but may occur at even higher temperatures. It can occur whenever the relative humidity is more than 50%.
- Throttle ice is formed at or near a partly closed throttle valve. The water vapor in the induction air condenses and freezes due to the venturi effect cooling as the air passes the throttle valve. Since the temperature drop is usually around 5°F, the best temperatures for forming throttle ice would be 32-37°F although a combination of fuel and throttle ice could occur at higher ambient temperatures.

In general, carburetor ice will form in temperatures between 32-50°F when the relative humidity is 50% or more. If visible moisture is present, it will form at temperatures between 15-32°F. A carburetor air temperature (CAT) gauge is extremely helpful to keep the temperatures within the carburetor in the proper range. Partial carburetor heat is not recommended if a CAT gauge is not installed. Partial throttle (cruise or letdown) is the most critical time for carburetor ice. It is recommended that carburetor heat be applied before reducing power and that partial power be used during letdown to prevent icing and overcooling the engine.

To prevent:

- Use carb heat ground check
- Use heat in the icing range
- Use heat on approach and descent

Warning signs:

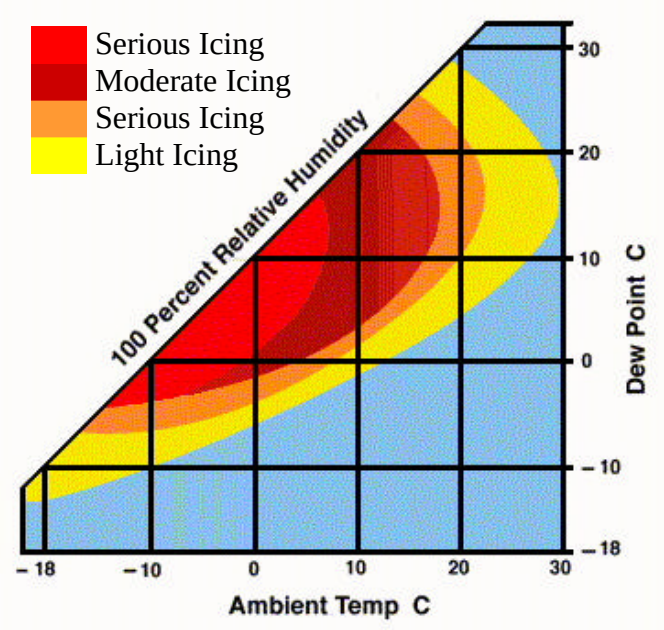
- Loss of rpm (fixed pitch)
- Drop in manifold pressure (constant speed) rough running

Pilot response:

- Apply full carb heat immediately (may run rough initially for short time while ice melts)
- The curves encompass conditions known to be favorable for carburetor icing. The severity of this problem varies with different types, but these curves are a guide for the typical light aircraft.

Caution - light icing over a prolonged period may become serious.

When you receive a weather briefing, note the temperature and dewpoint and consult this chart.



Carbon Monoxide Poisoning - Don't count on symptoms of carbon monoxide to warn you: It's colorless, odorless, and taste - less although it is usually found with exhaust gases and fumes. If you smell fumes or feel

any of the following symptoms, you should assume that carbon monoxide is present:

Feeling of sluggishness, warmth, and tightness across forehead followed by headache, throbbing, pressure at the temples and ringing in the ears. Severe headache, nausea, dizziness, and dimming of vision may follow. If any of the above conditions exist, take the following precautions:

- Shut off the cabin heater or any other opening to the engine compartment.
- Open a fresh air source immediately.
- Don't smoke.
- Use 100% oxygen if available.
- Land as soon as possible.
- Be sure the source of the contamination is corrected before further flight.
- Refer to the checklist for Smoke and Fumes Elimination.

AIRCRAFT PREPARATION

Most mechanical equipment, including aircraft and their components, are designed by manufacturers to operate within certain temperature extremes. Manufacturers generally can predict their product's performance in temperature extremes and outline precautions to be taken to prevent premature failures.

Baffling and winter covers - Baffles are recommended by some manufacturers to be used in augmented tubes. Winter fronts and oil cooler covers are also added to some engine installations. FAA approval is required for installation of these unless the aircraft manufacturer has provided the approval.

Engine Oil - The oil is extremely important in low temperatures. Check your aircraft manual for proper weight oil to be used in low temperature ranges.

Oil Breather - The crankcase breather deserves special consideration in cold weather preparation. A number of engine failures have resulted from a frozen crankcase breather line which caused pressure to build up, sometimes blowing the oil filler cap off or rupturing a case seal, which caused the loss of the oil supply. The water, which causes the breather line freezing, is a natural byproduct of heating and cooling of engine parts. When the crankcase vapor cools, it condenses in the breather line subsequently freezing it closed. Special care is recommended during the preflight to assure that the breather system is free of ice.

Hose Clamps, Hoses, Hydraulic Fittings and Seals - An important phase of cold weather preparation is inspection of all hose lines, flexible tubing, and seals for deterioration. After replacing all doubtful components, be certain that all clamps and fittings are properly torqued to the manufacturer's specifications for cold weather.

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 area. Each year accident investigations have revealed that carbon monoxide has been a probable cause in accidents that have occurred in cold weather operations.

If the temperature is zero or below, consider postponing your flight. Few light aircraft heaters are capable of handling subzero temperatures. Moisture from your breath can cause frost on the inside of the windows making it impossible to see. Control cable lubricants tend to gum up when it gets extremely cold.

Control Cables - Because of contraction and expansion caused by temperature changes, control cables should be properly adjusted to compensate for the temperature changes encountered.

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 proved 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.

Core of Batteries - Wet cell batteries require some special consideration during cold weather. It is recommended that they be kept fully charged or removed from the aircraft when parked outside to prevent loss of power caused by cold temperatures and the possibility of freezing.

Wheel Wells and Wheel Pants - During thawing conditions, mud and slush can be thrown into wheel wells during taxiing and takeoff. If frozen during flight, this mud and slush could create landing gear problems. The practice of recycling the gear after a takeoff in this condition should be used as an emergency procedure only. The safest method is to avoid these conditions with retractable gear aircraft. It is recommended that wheel pants installed on fixed gear aircraft be removed to prevent the possibility of frozen substances locking the wheels or brakes.

TAKEOFF

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

- Do not overboost supercharged engines. This is easy to do because at very low density altitude, the engine "thinks" it is operating as much as 8,000 feet below sea level in certain situations. Care should be exercised in operating normally aspirated engines. Power output increases at about 1% for each ten degrees of temperature below that of standard air. At -40°F an engine will develop 10% more than rated power even though RPM and MP limits are not exceeded.
- If the temperature rises, do not expect the same performance from your aircraft as when it was operated at the lower density altitudes of cold weather.
- 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 barely 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. It may be best to use carburetor heat on takeoff in very cold weather in extreme cases.

If your aircraft is equipped with a heated pitot tube, turn it on prior to takeoff. It is wise to anticipate the loss of an airspeed indicator or most any other instrument during a cold weather takeoff-especially if the cabin section has not been preheated.

If your aircraft your aircraft is equipped with cowl flaps, it may be advisable to perform the takeoff with the cowl flaps closed to prevent icing of the oil cooler. Check the aircraft POH.

Climbout - During climbout, keep a close watch on head temperature gauges. Due to restrictions (baffles) to cooling air flow installed for cold weather operation and the possibility of extreme 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.

LETDOWN

Engine Operation - During letdown 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 landing gear or flaps to keep the airspeed within limits. Carburetor heat may also be necessary to help vaporize fuel and enrich the mixture.

Blowing Snow and Ice Fog - 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 which may necessitate an alternate course of action.

Ice fog is a condition opposite to blowing snow and can be expected in calm conditions about -30°F and below. It is found close to populated areas, since a necessary element in its formation is hydrocarbon nuclei such as found in automobile exhaust gas or the gas from smokestacks.

Both of the above conditions can form very rapidly and are only a few feet thick (usually no more than 50 feet) and may be associated with clear en route weather. A careful check of the forecast, weather, and cautious preflight planning for alternate courses of action should always be accomplished.

POST FLIGHT

The following are a few items to consider before leaving the aircraft after the flight:

- As soon as possible fill the tanks with the proper grade of clean aviation fuel, even if the aircraft is going into a heated hangar.
- If the aircraft is to be left outside, put on engine covers and pitot covers.
- If the weather forecast is for snow or "clear and colder," put on rotor, or wing covers and save yourself from a snow or frost removal job in the morning.
- Control locks or tied controls are suggested if the aircraft is left outside, and there is a chance of high wind conditions. Tie downs are, of course, also suggested in high winds.
- If the aircraft is equipped with an oil dilution system, consider the advisability of dilution of the engine oil. If it is decided to dilute, manufacturer's recommendations should be carefully followed commensurate with the temperature expected.
- During engine shutdown, a good practice is to turn off the fuel and run the carburetor dry. This diminishes the hazard of a fire during preheat the next morning.

DOWNED AIRCRAFT

Dress for egress as well as for your in-flight comfort. Consider coats, gloves, hats and even some blankets for your passengers.

After a crash landing, it is best to leave the aircraft as soon as possible. Take time to analyze the situation and help others. Take care of any injuries first. Stay away from the aircraft until all gasoline fumes are gone. Sit down and think. Keep in mind that survival is 80% mental, 10% equipment, and 10% skills. Since mental factors are the number one problem, establish a goal to conquer regardless of the consequences. Don't have "give-up-itis" or a "do-nothing-attitude." Don't run off without taking time to think out each problem. Don't imagine things that are not there. There are basic fears in each of us. They are:

- Fear of the unknown
- Fear of darkness
- Fear of discomfort
- Fear of being alone

- Fear of animals
- Fear of death
- Fear of punishment
- Fear of personal guilt

Your MIND is the best tool for survival. USE IT!

- The number one enemy is yourself.
- The number two enemy is injuries.
- The number three enemy is temperature.
- The number four enemy is disease.

Whether to stay with the aircraft or start out on foot may be a major decision. Did you file a flight plan? If you did, it may be best to let them find you. Is your emergency locator transmitter operating? Do you have a survival kit? Don't fight a storm. Stay put and find shelter. Most storms are of short duration. What do you have in the aircraft that can be used to aid in survival?

- The compass will keep you going in one direction.
- Gasoline will help make a fire.
- Oil can be used for smoke signals.
- Seat upholstery may be used to wrap around feet or hands.
- Wiring may be used for tie strings.
- The battery may be used to ignite fuel.

Use whatever is available to protect the body from the loss of heat. Don't waste body heat by eating snow. Make a fire; heat water before drinking. You can conserve energy to last three weeks if you have water and stay dry. Body heat can escape 240 times faster from wet clothing than from dry clothing. It is best to eat small amounts of sugary foods to replace the energy lost through body heat. A good survival kit is well worth its weight. The following would be a useful kit; however, you can assemble an inexpensive survival kit of your own.

- First you need a metal container with a lid. This container can be used to heat water, make tea, use as a digging tool or polished as a signal mirror.
- Boy Scout knife.
- Small candle.
- Penny box of matches (wrapped in plastic).
- Leaf bag (pull over head, cut hole for face).
- Garbage bag (step in, pull up and tuck in pants or tie around waist). You now have body protection from heat loss.
- Sugar cubes (wrap in plastic, 6 to 12 cubes).
- Plastic tape.

The above is only a sample of what can be done. Use your own innovation and remember survival depends upon you.

Wind Chill - Without the wind blowing, the body (normally covered) can withstand a greater degree of cold. But let the wind blow, even a slight breeze, and the body heat loss can become critical. Of course, body heat is a product of energy. The chart below will give you an idea as to what to expect in equivalent temperatures. It also points a need for protective clothing or shelter. To use the chart, find the estimated or actual wind speed in the left - hand column and the actual temperature in degrees F. in the top row. The equivalent temperature is found where these two intersect. For example, with a wind speed of 10 mph and a temperature of -10°F, the equivalent temperature is -33°F. This lies within the zone of increasing danger of frostbite, and protective measures should be taken. It is emphasized that the wind chill chart is of value in predicting frostbite only to exposed flesh. Outdoorsmen can easily be caught out in 30° temperature. Winds of 30 mph will produce an equivalent wind chill temperature of -2 degrees

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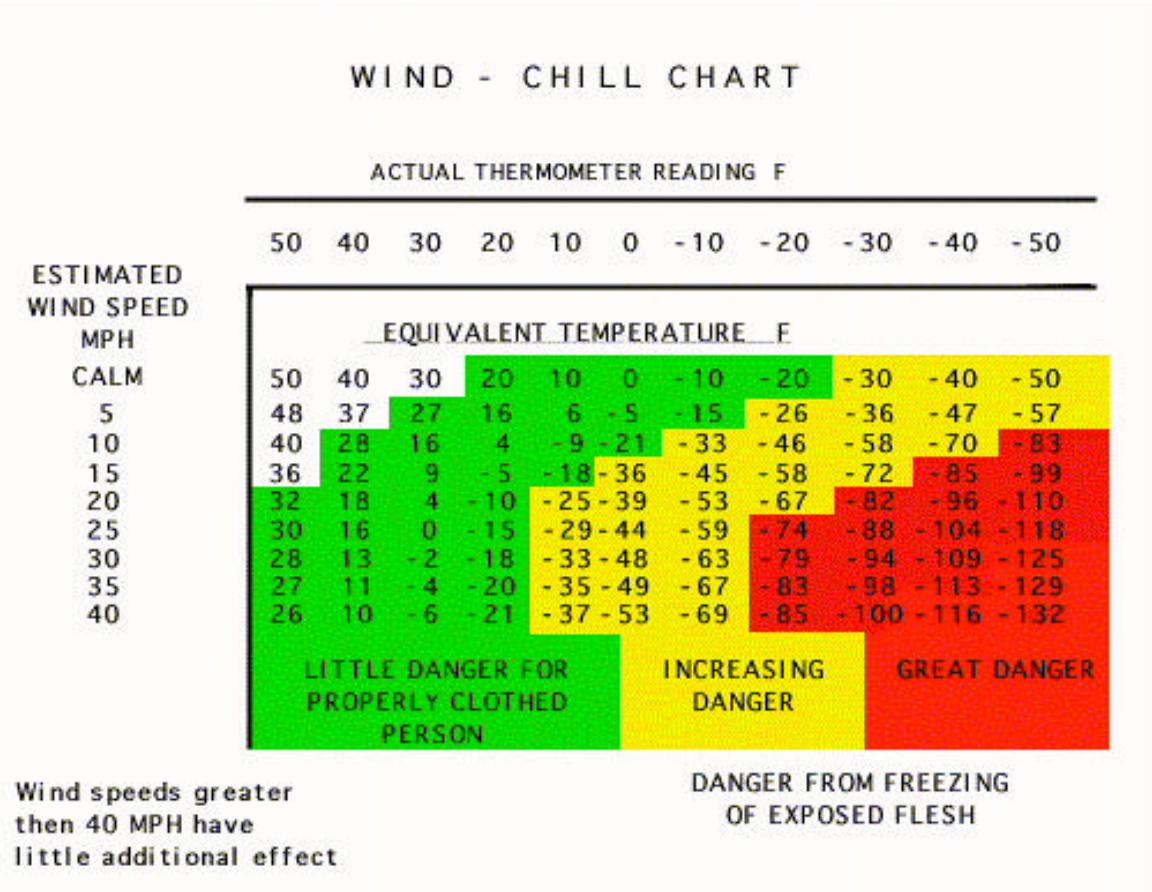

LIFE SUPPORT KIT

(Components of this vital kit may be found in most homes and garages.)

Container: Any Lightweight metal container with lid, suitable to heat and store water.

Life Support Tools:

- Hack saw - Single handle with wood blade and metal blade
- Vise - grip pliers
- Slip - joint pliers
- Screwdriver set

Personal First Aid Kit:

- Sealable Plastic Container
- 2 - Compress bandages
- 1 - Triangle bandage
- Small roll 2" tape
- 6 - 3 x 3 gauze pads
- 25 - Aspirin /LI
- 10 - Band - Aids
- Razor blades or scissors
- Hotel size soap
- Kotex - purse size
- Kleenex - purse size, or toilet paper
- 6 - safety pins
- 1 - Small tube of Unguentine or Foile

Shelters (minimum of 2)

- Large plastic sheets - 9' x 12' Heavy gauge (one for each person) colored red or yellow preferred for signal panels.

Life Support Kit

- Waterproofed matches
- Candle or fire starter
- Signal mirror
- Small compass
- Knife - Boy Scout style
- Insect repellent
- Mosquito net
- Whistle
- 50' of 1/8" nylon rope or shroud line
- Smoke flares or red day - night flares
- Food and Energy Package - (1 person/5-day rations) 2 or 3 cans of Sego, Nutriment or Metrecal for liquid and energy
- 30 - wrapped sugar cubes
- 10 - pilot bread or 25 crackers

- 10 - packets of salt
- 3 - tea bags
- 12 - rock candy
- 5 - gum
- 10 - bouillon cubes
- 20 - protein wafers (if available)

Use poly bags for water storage

Put each item in small plastic bag and seal. Put everything in small metal can (cook pot), seal with poly bag and tape.

Requirements for Life:

You can live without it approximately:

Air	3 minutes
Body Shelter	6 hours in severe weather
Water	3-6 days
Food	3 weeks
Will to live	?????

This information was heavily paraphrased (read plagiarized) from Jim Cavanagh's *Get A Jump on Winter!* , the FAA General Aviation Accident Prevention Program paper: *Tips On Winter Flying*, and *How to Fly in the Cold* by Robert N. Rossier. The *Get A Jump on Winter!* full article can be found in the September 2000 issue of the Cessna Owner Magazine. The *Tips On Winter Flying* can be found at http://www.faa.gov/ats/afss/newyork/WINTER-T.HTM #TOC . *How to Fly in the Cold* is from the December 1993 issue of Flight Training magazine.