THE ALASKA AIRMEN'S ASSOCIATION

Ski Flying Hints by Alaska Airmen Association, Inc.

Schussing with your Cessna (or Piper, or Whatever)

Flying on skis is actually easier in many ways than aviating with wheels or floats. You do not need a separate endorsement or rating on your pilot certificate to fly skis, nor does your airplane require a major modification or STC. If you can fly your plane proficiently on wheels, you can probably do so on skis as well, although there are enough differences in flying skis so that a few flights with a knowledgeable ski pilot would be highly advisable.

Most planes can be outfitted with skis. Conventional-geared airplanes are somewhat easier and cheaper to put on the boards, if for no other reason than only two skis are required. Tri-gear skis must include some kind of nose ski; there are several types available. A warning, though: nose skis can be difficult to steer on the ground at low taxi speeds, especially for Cessna 182s and 206s, which tend to be very nose-heavy under some loading configurations.

Tail skis are strictly optional: some people prefer not to install tail skis because they like the braking action available from a tailwheel in the snow. On the other hand, smaller airplanes with less powerful engines often benefit from a tail ski; tail skis improve maneuverability on the ground, sometimes considerably.

Wheel skis come in two flavors: wheel penetration and hydraulic. Wheel penetration skis such as Schneiders or Landes are designed to let a small part of the tire protrude below the ski bottom. These skis inherently have more drag than straight skis or hydraulic skis, and tend to be poorer performers in deep or crusted snow. On the other hand, penetration skis are excellent for slushy, patchy, and light snow conditions. They also have the advantage of simplicity and fairly light weight. Some penetration skis have plates that can be manually installed under the wheels to turn them into straight skis.

Hydraulic skis are like constant-speed props--they are heavier and more complex (and more costly) than straight or penetration skis, but they offer better performance. Hydraulic skis generally operate through a manual pump in the cockpit, activation of which forces the skis down and under the wheel or out and up away from the wheel, depending on the selector position. Some hydraulic skis force a moving plate under the wheel to force it up and out of the way, but the net effect is the same.

All modern skis **(and old** ones that have been updated) have bottoms of tough plastic. Most also have some kind of metal skag or runner on the bottom to help with directional stability on icy surfaces. It is possible to install hydraulic ski brakes, which consist of a metal rods that can be forced down through the ski bottom by pressing on the brake pedals; these are generally most effective on icy or snowpacked surfaces.

Skis are rated in the same manner as floats: theoretically each ski must be rated to support a certain percent of the gross weight of the airplane. The ski rating does not necessarily equate to the surface area (or flotation) of the ski; rather, the rating has to do with the weight-bearing capability. A good rule of thumb is to get skis that can support the entire gross weight of your airplane. Most small two-seat taildraggers like Cessna 140s, Luscombes, Champs, and Chiefs seem to do well with 1500s or even 2000s; Super Cubs need at least 2000s; for Cessna 170s, 2500s seem to be the standard; for 180s and 185s, 3000s, 3200s, 3500s, 3600s, or even 4000s are the order of the day.

For tri-gears, the ski rating applies to the main gear. However, nose skis should be strong enough to support whatever percentage of the load is customarily carried by the nose gear. For example, on an empty (and thus nose- heavy) Cessna 206. the load on the nose ski can be 60 percent of the total airplane weight.

Many pilots like to get as much flotation (surface area) as possible on their skis, although too much flotation can result in excessive drag and poor performance. In general, bigger airplanes with bigger engines benefit more from extra flotation. In any case, no amount of flotation will prevent getting stuck in several feet of soft powder snow.

Putting on skis requires installing suitable attach points for the rigging. Each ski must have a rear cable to keep it at the proper angle while inflight; this angle depends on the particular ski-airplane combination. Each ski must also have a front spring (or bungee) to keep it in tension against the rear cable, as well as a check cable to keep it from dipping (or drooping) too far if the spring or bungee breaks.

A droop ski--even if caught by the check cable--can be a very serious event and can cause loss of control of the airplane because of the sudden pitch-down moment. For this reason use of a spring instead of a bungee is highly recommended. Similarly, it is desirable to install cable attach tabs in such a way that the cables act most directly on the skis (i.e., as perpendicular to the plane of the ski as possible).

Skis also require steel axles; some planes have aluminum axles, which are not suitable for ski use. In some cases, steel axles may need to be turned down on a lathe to allow the ski bearings to fit smoothly; a steel spacer will then be necessary for wheel use. For hydraulic skis, special extended ski axles may be required.

The initial ski installation can take several hours, especially if tabs must be installed in inconvenient locations. Initial rigging can be time-consuming as well, and involves elevating the tail of the airplane to the inflight attitude. However, once the tabs are on and the rigging is set up, subsequent installations are usually easy and can take as little as half an hour. Ski installation and removal normally require only an entry in the aircraft log by an A&P.

Once the skis are installed, some essential gear needs to be "installed" in the airplane. Most important: a good pair of snowshoes is absolutely mandatory--and expect to use them. Other key items include a length of two-by-four (maybe three or four feet), heavy plastic trash bags (or a roll of visqueen), and duct tape; the utility of these things will shortly become apparent.

Slipping and Sliding Successfully

The ability of a ski to slide across the snow is dependent on its ability to instantaneously melt individual snow or ice crystals through the heat of friction. The ski then slides on the vanishingly thin layer of water thus created, which then freezes almost instantly after the ski has passed over it. The ski's capability to generate this water layer is dependent on several factors.

Most importantly, the ski must be moving. A stopped ski generates no friction. The faster the ski moves, the more its kinetic energy increases, as does its capability to melt snow and slide more easily. In practice, the faster a ski goes, the less its coefficient of friction becomes: the faster it goes, the easier it slides.

However, there is a practical limit beyond which the residual drag of the snow will pretty much balance the available power--just like trying to break the suction of the water on a heavy float takeoff. Where a particular airplane reaches this break-even point can vary widely; in some cases, the airplane may not be able to go faster than a brisk walk. In others, this may not even be a factor. Obviously, any factor that can shove this point back is highly desirable. While a ski depends on friction to generate its water layer, too much friction is un-good. In fact, the ski bottom should be as smooth as possible; even a mildly rough surface can be a major problem. Badly scratched or ripped plastic bottoms can significantly reduce the "slick factor", as can frost, ice, or frozen snow adhering to the ski bottoms. Modern plastic bottoms are less likely to accumulate frost and frozen snow than older metal bottoms, but they can easily pick up enough to render them immovable if left for very long in some conditions.

Also, temperature, snow condition, and snow depth play a very important part. Sticky snow can negate even the slickest skis. Plowing through heavy, wet snow is like trying to run on a soft sand beach. Deep powder snow can literally swallow an airplane up to the belly or even the wings. Any combination of these and other factors can prevent a skiplane from even moving, much less taxiing or taking off.

Lastly, weight is a much bigger player on skis than on wheels. In less than ideal conditions (ideal being hard snowpack) it may be very difficult to coax a heavy airplane to move on skis. It may be impossible to convince the same plane to take off even if it can be made to move.

For most planes, just getting moving can be a major problem. A lot of getting started depends on how the airplane was stopped. There are several tricks that might help:

Always park the plane on hardpack or at least on existing ski tracks; if this means some extra taxiing to make a parking zone, do so. Don't park the plane in snow that is wet from below, such as from water seepage or overflow (at least not in temperatures below freezing). Make sure the ski bottoms will stay clean and won't freeze to the snow or ice. Parking on blocks or boards so that the bottoms don't touch the snow isn't a bad idea. Some people park on oil-soaked mats.

Others put visqueen under the skis when they park. Even spruce boughs work to keep the skis off the snow.

If the skis do get frozen in or frosted up, no amount of engine power will get them to move. The only options are to unfreeze them, remove the roughness from the bottoms, or simply cover up the non-skid bottoms long enough to get airborne. Rocking the wings can often pop skis loose. Sometimes lifting on the tips can break the rest of the ski free. If the skis won't budge, a two-by- four or equivalent might be useful to pry them up. Once the skis are free, they can be elevated enough to scrape off much of the frost, ice, or frozen snow. Red Dragon heaters are also useful to clean ski bottoms.

If all else fails, wrapping visqueen or even heavy plastic trash bags around the skis and then taping them with duct tape will allow taxi and takeoff. (The plastic will blow off once airborne, and the skis can then be scraped clean with a high-speed touch-and-go or two.)

Under normal conditions, the skis will begin to slide when the engine power exceeds the static drag. If lots of power won't make them move, working the rudders side to side often works. Bouncing the tail up and down with the elevators isn't always a good idea because it can create heavy stress on the empennage area and isn't as effective as using the rudders. Having a willing bystander rock the wings during the above will also help considerably.

Once the airplane is moving, the art of ski taxiing is to maintain enough speed to keep moving without going too fast for conditions. The slower the speed, the faster the skis will grab and try to stop. Stopping inadvertently while taxiing can cause big problems if the airplane stays stuck.

Stops obviously need to be planned. The airplane will usually stop on skis faster than most people think, although all bets are off on glare ice or with a brisk tailwind. Some people (such as some of the Talkeetna air taxis operating Cessna 185s) don't use tail skis in order to take advantage of the stopping power of a tailwheel when it's really needed. Hydraulic ski brakes are. of course, a good idea for those who have them.

Turns MUST be anticipated. Given a choice, ski turns should always be made to the left to take advantage of engine torque. The amount of room needed for a turn will vary on many conditions, but allow at least five or six wingspans as a bare minimum. Turns should be entered smoothly and extreme care should be taken to avoid putting excessive load on the gear on the outside of the turn. Speed should be kept to the minimum needed, and turns on rough_or rutted surfaces should be kept as slow as possible.

With a heavy airplane, turning on skis may be difficult in heavy or soft snow. With taildraggers, smartly applying power while pushing the desired rudder and nose-down elevator will make things easier by raising the tail at least partly out of the snow and allowing the prop blast to hit the rudder, thus facilitating the turn. With tri-gears, use power and nose-UP elevator to lighten the load on the nose gear and allow it to turn more easily. In any case, more prop blast will reach the empennage to help things if the flaps are up.

If in narrow confines (like a runway) where there's no room to turn normally, two options are available. First is for the pilot and his long-suffering passenger(s) to get out and physically turn the airplane around by pushing/pulling/lifting/cursing the aft end of same. Second is for the passenger or an innocent bystander to hold gamely onto the strut while the pilot applies power and nose-down elevator to pivot the aircraft. Done carefully, either will work, and may be the only means to reverse course for takeoff.

When turning, always remember that the ski's length allows it to generate enormous twisting moments on the axle and gear leg, far more than a wheel. Too much speed or too sharp a turn WILL cause the outside ski to dig in, even on otherwise good surfaces; this can easily cause the gear leg to twist and collapse, or snap off the axle. Equally as bad is allowing the skis to slide sideways on ice or packed snow; if they suddenly hit a bare patch or obstruction, a ski can catch and flip the plane or collapse the gear. Light-plane gear was not designed for the high-intensity side loads that skis can cause. A ground loop on skis usually means major structural repairs because the gear will probably be seriously damaged.

Slipping the Surlies on the Slats

Ski takeoffs can often be the most difficult aspect of ski flying. Like floats, it's possible to motor for great distances without becoming airborne if things don't go just right.

The best ski takeoff procedure is usually the same as the soft-field takeoff procedure. The idea is to get airborne as quickly as possible, away from the grasping snow. In general, a lot more bad things can afflict an airplane moving a high rate of speed on snow or ice than can befall it in the air.

Always plan for more takeoff run than with wheels--sometimes a lot more. Wet, sticky snow is worse than mud or even beach sand for impeding a takeoff. Similarly, trying to take off in deep snow is often just not possible, at least until it has been packed down. Even hardpacked surfaces can be fiendishly tricky in crosswinds.

Given a choice, always take off as directly into the wind as possible. Under many conditions, skis cannot slip like wheels and a crosswind will tend to lift a wing--and to continue to lift it. Likewise, every little bit of headwind will help lighten the plane and reduce the friction on the snow, and heading into the wind will minimize the twisting moment and side loads on the gear.

A rolling (or rather, sliding) takeoff is desirable under most conditions. The runup will probably have to be performed on the initial part of the takeoff run if it cannot be done while taxiing. If the airplane doesn't want to fly when it should, consider popping another notch of flaps to break it free (if this is an option). Also consider lifting one ski (just like on floats).

A major cause of long, scary ski takeoffs is trying to make them in open snow. The laws of physics are unequivocal on this point: taking off through open snow will significantly increase and possibly even stifle a ski takeoff run. There are some situations where open-snow takeoffs can be a lot of fun, but more often than not they are major ulcer producers, especially with heavy or underpowered airplanes. Always use existing tracks for takeoff if available; if they're not, make some, either after landing or before taking off. If worse comes to worse, use snowshoes to pack a runway.

If possible, don't plan to make a turning takeoff, such as around the bend of a river. Inevitably, this requires a high-speed "step turn" that can generate hideous side loads on the gear. When a plane and pilot are thus exposed, all it takes is one half-buried snowmachine track or rut to cause a real mess, or worse.

Settling on a Soft Snowy Surface

Landing is often the most delightful part of flying on skis. A soft letdown into half a foot of fresh powder on a virgin lake can be positively sensuous. On the other **hand,** banging down on glare ice on a short, narrow runway with high berms on each side and trees at the far end can be enough to make a pilot want to become a pedestrian.

It almost goes without saying that properly picking a landing area is of utmost importance. It must be within the capabilities of both the airplane and the pilot--and there are some cases where a landing just isn't possible. There are so many possible permutations of landing situations that a comprehensive listing just isn't possible. However, here are a few hints:

-- Always land into the wind if possible, and as slowly as possible. Without brakes, slowing down can be a major concern, and every mile an hour less over the threshold is a mile an hour less to lose on the landing run.

-- Don't drop the airplane in. Make the landing as smooth as possible to keep the ski tips up. Dipping a ski tip on landing is a sure way to ruin a day.

-- Always use a packed runway or at least somebody else's tracks for landing if possible. There are literally thousands of ski strips around the state every winter. Open snow landings can be fun, but they can easily get out of control. -- On lakes and rivers, snow depths are usually not a problem, but overflow can ruin an otherwise great landing area. Sometimes overflow is visible from the air as darker patches in the snow cover. Overflow is more prevalent near inlets and outlets of lakes. It is possible to check for overflow by making a touch and go on the intended landing area and then circling overhead to see if the tracks become darker--meaning water is seeping into them from below.

-- Drifts can be big trouble and must be avoided for landings and takeoffs. Even little four-inch snowdrifts can feel like speed bumps and can unmercifully stress the landing gear. It is often possible to find a smoother area behind a peninsula or in a cove.

-- Snow-covered swamps and marshes can conceal all manner of nasty things. Plan on much deeper snow in these areas, often underlain by deep grass that will collapse under the weight of the airplane, making the effective snow depth much more than actual. Also beware of tussocks and other bumps under the snow that can wipe out the gear or cause a wingtip to hit the snow. -- Be extremely cautious when landing on glare ice or mostly-ice surfaces. Lakes and rivers can freeze with cracks and pressure ridges that can grab skis. Also, skis on ice have about the same stopping power as a United Nations resolution in Bosnia. If the trees and shrubs are arriving rapidly and there's no way to safely make a go-around, make an intentional ground loop by adding power, pushing the nose over (or pulling it up, for tri-gears), kicking full left rudder, and then pouring on the power to decelerate the by-now-backward slide. Chances are, the skis will spin on the ice without grabbing and no damage will be done--except maybe to the pilot's ego.

-- If in doubt of snow depth, don't. No ski known to man will keep a plane afloat in three or four feet of unconsolidated powder. A sure sign that the snow is deeper than anticipated is when the windshield is blanked out from snow thrown up by the propeller. Some pilots carry black plastic bags filled with charcoal or other eco-friendly substances (like rocks) to toss out in questionable areas. If the bag sinks out of sight, go somewhere else.

-- Avoid flat-light situations in open snow like the plague. It can be absolutely impossible to see a four-foot drift directly in the touchdown zone, assuming it is possible to judge height above the snow accurately enough to even land in same. If it's absolutely necessary to land, toss out some black plastic bags on a pass over the landing area--they make fine impromptu runway markers and depth perception references. (If you can't see them after you drop them, refer to the immediately preceding paragraph.)

-- For open snow landings, be prepared to add power quickly once on the surface, either for a go-around or simply to keep moving to get to a suitable stopping area. It may be advisable to make a touch-and-go (or even several) to establish a set of tracks. If possible, continue taxiing in a complete loop at the end of the landing area and stop on the tracks heading back for takeoff. Ideally, make a loop at both ends of the runway; this "dog-bone" layout is the norm for most bush ski strips.

Oops…

Every ski pilot will get stuck at some point. It's just part of life in the fast lane. The thing to remember is that getting stuck isn't the end of the world. Most McKinley glacier pilots hav The most common kind of stuck is when one ski digs in, creating a lopsided airplane and an agitated pilot. The solution requires: a) a shovel, b) snowshoes, c) hopefully some help from passengers, and d) lots of elbow grease. First, dig the snow from under the high ski to make it more or less level with the sunken one. Second, dig ramps for the skis back up to the top of the snowpack. Third, if the snow is very deep, snowshoe out a path to the runway or takeoff area. Fourth, make sure the prop is clear (the prop won't generate much thrust when it's eating snow). Fifth, position any available manpower on the struts to help rock and push. Lastly, apply power as required to move the airplane back up onto the snow in a level attitude.

Getting stuck can also involve getting in over one's head--literally. If the snow has swallowed the airplane up to the armpits, it's snowshoe time. In this type of situation, the snowshoes will be absolutely essential merely to move around, much less extricate the airplane. Once properly shod, the first action is to stomp out a path to safety, or a whole runway if necessary. Next comes a shovel (or whatever works) to make a ramp in front of the airplane. After this point, it's a matter of power and finesse to get safely parked or airborne, as desired.

The worst kind of oops is getting frozen in overflow. If the overflow is shallow, and the skis have been wrapped in visqueen or plastic bags, the solution is often just a matter of rocking the plane until the skis are back on top of the surrounding ice, followed by as expeditious a departure as possible before more freezing occurs. If the frozen overflow is deep, the only answer is an ax or chainsaw to remove the entrapping ice. It is entirely possible for skis to become frozen in so deeply that the airplane will stay in place until spring. Where overflow is concerned, an ounce of prevention is worth a glacier of cure.