SAFETYSENSE LEAFLET 3
WINTER FLYING

1 INTRODUCTION

The purpose of this leaflet is to advise pilots/operators of aeroplanes, helicopters and microlights of some of the problems they may encounter while flying in winter.

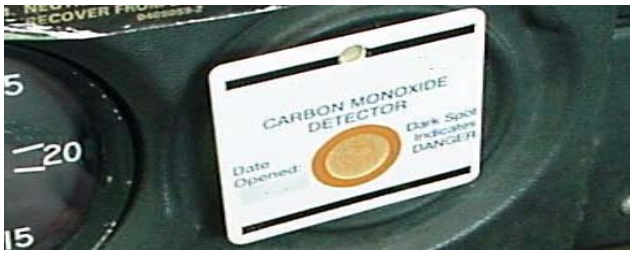
2 AIRCRAFT PREPARATION

a) During the pleasant days of summer, items of equipment may have 'disappeared'. Make sure the aircraft has serviceable pitot head covers, static vent plugs, control surface locks and, if parked outside, proper tie-downs. Having made sure you have got them – **use** them.

b) Some engines may need the aircraft manufacturer's approved winter cooling restrictor to allow the oil and cylinders to reach and maintain correct operating temperatures. After fitting, keep an eye on the oil temperature/cylinder head temperature, especially if the weather turns warmer.

c) The grade of engine oil may need to be changed when operating in colder conditions. Consult the Manufacturer's Manual or Maintenance Organisation.

d) Check that the cabin heater/demister is working properly before you really need to use it. A faulty cabin heater, either combustion or exhaust, can allow exhaust gases, including carbon monoxide, into the cabin. If in doubt, have the heater pressure-tested. Carbon monoxide is colourless, odourless, tasteless, insidious in its effects and lethal. One of the first symptoms may be a severe headache, drowsiness or dizziness.



e) 'Spot' type carbon monoxide detectors only have a limited life when unwrapped. Use a 'fresh' one and read the instructions.

f) The pitot-static system should be checked for water which can freeze and block the system. If static drains are fitted, know where they are and how to use them.

g) The battery is worked harder in winter, so make sure it is in good condition and well charged. If you've had to make prolonged attempts to start the engine, when it does start allow plenty of time for the battery to re-charge before using heavy electrical loads. In a single-engined aircraft it's all you are left with if the electrical charging system fails in flight.

h) Some aircraft require the addition of Iso-propyl alcohol in the fuel for operation in low ambient temperatures. (See Flight Manual.)

i) Check that all the airframe, propeller and windscreen systems are operating correctly. De-icing systems suffer from neglect and may prove faulty when required. Leaks may have developed in inflatable boots especially on the tailplane (due to stones thrown up by the landing gear/propellers), so check that they ALL inflate properly.

j) Make sure engine crankcase oil breather pipes are clear and free from deposits which can freeze, causing a pressure build-up that could force engine oil seals out of their housings.

k) Control cable tensions may need to be adjusted.

3 FLIGHT PREPARATION

a) If you are planning to visit another aerodrome, make sure it is open. Mud, snow, flooding or frozen ruts may have necessitated closure. Daylight and airport operating hours are also much shorter in winter.

b) **Never** fly in icing conditions for which the aircraft is not cleared. Do not be misled into thinking that because an aircraft is fitted with de-icing, or anti-icing, equipment, it is necessarily effective in all conditions. Most general aviation aeroplanes are not cleared for flight in icing conditions, although some protection may be given. Those cleared are

generally cleared only for flight in light icing conditions (the equivalent of a build-up of 12 mm (1/2 inch) of ice in 40 nautical miles). General aviation helicopters are *not* cleared. (See Pilots' Operating Handbooks, Flight Manuals, etc.)

c) Continued flight into bad weather is the number one killer in UK general aviation. Get an up-to-date aviation weather forecast. The current 'GET MET' booklet explains how (copies available from the Met Office).

d) The most likely temperature range for **airframe** icing is from 0 to -10°C; it rarely occurs at –20°C or colder (see paragraph 6(c) for carburettor icing conditions). Pay attention to any icing warnings. Note the freezing level, it can be surprisingly low even in spring and autumn; you may need to descend below it to melt an ice build-up; but **beware of high ground**. Remember also that altimeters over-read in very low air temperatures, by as much as several hundred feet. You can be lower than you think.

e) If you are likely to encounter ice en-route, have you room to descend to warmer air? Will the airspace or performance allow you to climb to cold, clear air? (Note that any ice build-up may not melt and will degrade cruise performance.) Can you land safely at your destination? If the answers to these questions are NO, **don't go**.

f) Prepare an accurate route plan with time markers, including an alternative in case you do encounter ice/snow. The countryside looks very different when covered by a blanket of snow and familiar landmarks may have disappeared.

g) Wet snow, slush or mud can seriously lengthen the take-off run or prevent take-off altogether. Check the Flight Manual and SafetySense Leaflet 7 '*Aeroplane Performance'*, and allow a generous safety margin, especially from grass.

h) Have a cloth handy for de-misting the inside of the windows while taxiing.

i) Dress sensibly (you should spend some time outside whilst pre-flighting the aircraft), and have additional warm clothing available in case of heater failure or a forced landing.

j) Some parts of the UK will be pretty inhospitable in winter (e.g. much of Wales and Scotland) so, especially if you are in a single-engined aircraft, file a flight plan and carry a few survival items in case of a forced landing. Warm clothing is essential, but consider a Personal Locator Beacon, as well as a silvered survival bag, torch/mirror and whistle for signalling.

k) Be prepared to divert and carry a night-stop kit. **Don't** put pressure on yourself to get home if the weather deteriorates.

l) Read AICs 86/2007 (Pink 126) 'Risks and Factors Associated with Operations on Runways Contaminated with Snow, Slush or Water' and 106/2004 (Pink 74) 'Frost, Ice and Snow on Aircraft'. These are orientated to larger aircraft but do have useful information for General Aviation.

m) When snow has fallen, check SNOWTAMs in the NOTAM series, if available, to find out if your proposed destination, and alternate(s), are open and which operational areas have been cleared. If there is an eight-digit code at the end of a METAR, it shows that winter conditions affect that aerodrome. It may be easiest to telephone them. The first two digits of the eight-digit code are the runway, and the last two the braking action. AIP GEN paragraph 3.5.10.12 gives further details/decode. Know the effect that braking action described as, for example, POOR will have on the landing/abandoned take-off distance you need to have available. Bear in mind the effects of a crosswind combined with an icy runway.

4 PRE-FLIGHT

a) There may be a greater risk of water condensation in aircraft fuel tanks in winter. Drain fluid from ***all*** water drains (there can be as many as 13 on some single-engined aircraft). Drain it into a clear container so that you can see any water.

b) When refuelling, ensure the aircraft is properly earthed. The very low humidity on a crisp, cold day can be conducive to a build-up of static electricity.

c) After flying high such that integral wing tank fuel has been 'cold soaked', and the ambient air is humid and cool, frost will form. If it is raining, almost invisible clear ice may form.

d) Tests have shown that frost, ice or snow with the thickness and surface roughness of medium or coarse sandpaper reduces lift by as much as 30% and increases drag by 40%. Even a small area can significantly affect the airflow, particularly on a laminar flow wing.

e) Ensure that the entire aircraft is properly de-iced and check visually that **all** snow, ice and even frost, which can produce a severe loss of lift, is cleared. This includes difficult-to-see 'T' tails. If water has collected in a spinner or control surface and then frozen, this produces serious out-of-balance forces. **There is no such thing as a little ice**.

f) The most effective equipment for testing for the presence of frost and ice is your eyes and your hands.

g) The best way to remove snow is by using a broom or brush. Frozen snow, ice and frost can be removed by using approved de-icing fluid in a pressure sprayer similar to a garden sprayer. An alternative is to melt the ice with hot water and then leather the aircraft dry to prevent re-freezing. Make sure that control surface hinges, vents etc. are not contaminated. A scraper might damage aircraft skins and transparencies.

h) Do not rely on snow blowing off during the take-off run. The ‘clean aircraft concept’ is the only way to fly safely – there should be nothing on the outside of the aircraft that does not belong there.

i) Check that the pitot heater really is warming the pitot head – but don't burn your hand (use the back of it) or flatten the battery.

j) Beware of wheel fairings jammed full of mud, snow and slush – particularly mud, as it is dense and doesn't melt (on one occasion 41 kg, nearly 100 lb, of mud was removed from the three wheel fairings of a four-seat tourer). If the fairings are removed, there may be a loss of performance and removal may invalidate the aircraft's C of A. Check that retractable gear mechanisms are not contaminated. Also, remove mud from the under-side and leading edge of wings and tailplane; it seriously affects airflow.

k) Water-soaked engine air intake filters can freeze and block the airflow.

l) If hand-swinging a propeller, perhaps because of a flat battery, move the aircraft to a part of the airfield which isn’t slippery. Use chocks and a qualified person in the cockpit. Don’t try it unless you’ve been trained.

m) If using external power, you may need to ensure that master switches are OFF until external power has been removed.

n) During the engine run-up, check that use of carburettor heat gives a satisfactory drop in rpm or manifold pressure.

o) Check de-icing boots, particularly the tailplane, for condition, holes etc. Wiping the boots with approved anti-icing fluid will enhance their resistance to ice build-up.

5 DEPARTURE

a) Remember that taxiways and aerodrome obstructions may be hidden by snow, so ask if you are not certain.

b) Check the cabin heater/demister operation as early as possible. Be prepared to use the DV window.

c) Taxi slowly to avoid throwing up snow and slush into wheel wells or onto the aircraft's surfaces. Taxiing slowly is safer in case the tyres slide on an icy surface. Stop well clear of obstructions if there is any doubt about braking effectiveness.

d) Allow gyro instruments extra time to spin-up when they are cold.

e) You may consider using a 'Soft Field' take-off technique – if so be sure that you are fully aware of recommended procedures.

f) Ensure that no carburettor ice is present prior to take-off by carrying out a 15-second carb heat check as in SafetySense Leaflet 14, both during power checks and before take-off. Ensure the engine is developing full power before taking off.

6 EN ROUTE

a) After take-off on a slushy or snowy runway, select the gear UP-DOWN-UP. This may loosen accumulated slush before it freezes the gear in the up position.

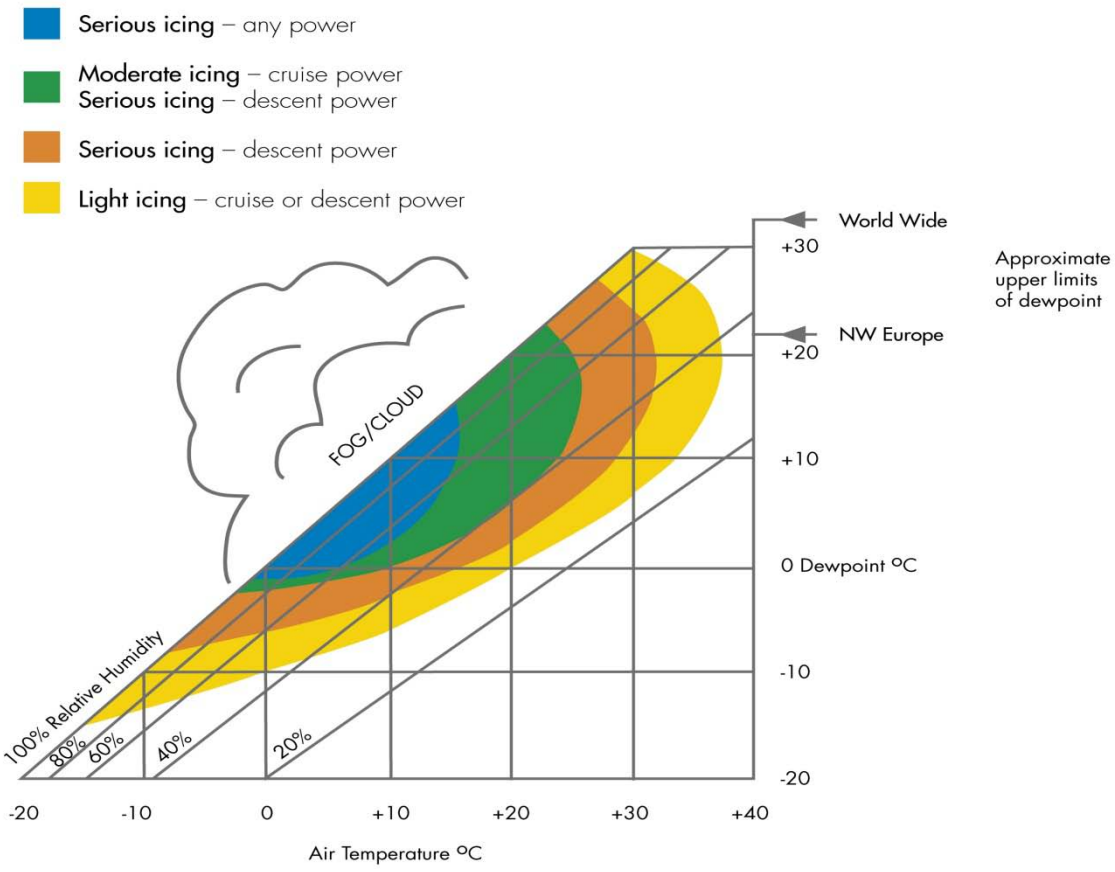
b) Check conditions with Flight Information or monitor VOLMET, and turn back or divert early if the weather deteriorates. **Don't** wait until you are in a blinding snowstorm or covered in ice.

c) Carburettor icing is one of the worst enemies. The chart shows when it is most likely to occur. (See also SafetySense Leaflet *14 – 'Piston Engine Icing'*.) In the absence of dewpoint information, assume high humidity when:

- the ground is wet (even dew);
- in precipitation or fog; or
- just below cloud base.

d) Carburettor ice forms stealthily, so monitor engine instruments for loss of rpm (fixed-pitch propeller) or manifold pressure (constant speed propeller), which may mean carb ice is forming.

e) Apply full carb heat periodically (every 10-15 minutes) and keep it on long enough to be effective. As a guide, carb heat should be applied for a minimum of 15 seconds, or longer if necessary. The engine may run roughly for a short period while the ice melts.



f) Use carb heat as an intermittent ON/OFF control – either full hot or full cold. Do not use carb heat continuously or at high power settings unless the Handbook/Flight Manual allows it. At low power settings, e.g. descent, the application of heat **before** reducing power, and its continuous use while power is low, is recommended.

- During a descent, when using small throttle openings, with full carb heat, increase rpm periodically to warm the engine.
- Remember carb hot air increases fuel consumption.
- At low rpm, use full heat but if appropriate cancel it prior to touchdown in accordance with Manual/Handbook instructions.

g) If the aircraft has de-icing boots, it's a good idea to cycle the boots from time to time, even when ice is not expected. This prevents the valves in pneumatic systems from sticking.

h) If you are flying just above clouds to stay clear of airframe icing, remember that the cloud tops will quickly rise as you fly:

- across high ground;
- towards a warm, cold or occluded front; or
- towards a low pressure area.

If you fly into the top of clouds, the concentration of water droplets is often greatest near the cloud top and ice could build up quickly.

i) Airframe Icing is most frequently encountered within convective clouds, Cumulus or Cumulonimbus (CU/CB) where the build-up of ice can be very rapid. In these clouds the icing layer can be several thousand feet thick and a dramatic change of altitude will be required to avoid icing. It is better to avoid flying through these clouds if you can, either by turning back or changing your route.

Icing can also occur in thin layered clouds, especially during the winter. During the autumn, winter and spring an extensive sheet of Stratocumulus (SC) may frequently form just below a temperature inversion, with the temperature in the cloud between 0 and –10°C. Such clouds may only be one to two thousand feet deep but within the cloud layer ice may build up quickly. This icing can be avoided by descending below the cloud, provided there is sufficient height available above the ground, or by climbing above the cloud layer, but remember paragraph (h).

j) If you see ice forming anywhere on the aircraft, act promptly to get out of the conditions, don't wait until the aircraft is loaded with ice. Ice forms easiest on thin edges. As the tailplane generally has a smaller leading edge radius than the wing it means that if you can see it on the wing, the tailplane (or propeller blades) will already have a heavier load. Pilots have reported that ice builds up three to six times faster on the tailplane than the wing and up to double that on a windshield wiper arm. On some aircraft the tailplane cannot be seen from the cockpit. In fact the pencil-like OAT probe is often the first place ice forms. If ice does form, keep the speed up; **Don't fly too slowly**. The stall speed will have increased. The Manual/Handbook may give a minimum speed to cope with increased drag and weight due to ice build-up.

k) The stall warning system may be iced up or otherwise affected. It is in any case designed and calibrated to provide indication of wing stall, not the tailplane!

l) If ice has formed, drag and weight are increasing while the climb performance is decreasing, so you can't climb to get above it. High ground may prevent a descent.

m) Tell ATC so that others can be warned.

n) Snow, which is already frozen, will usually only stick to an aircraft if it has a high moisture content. If it does so, treat it like ice.

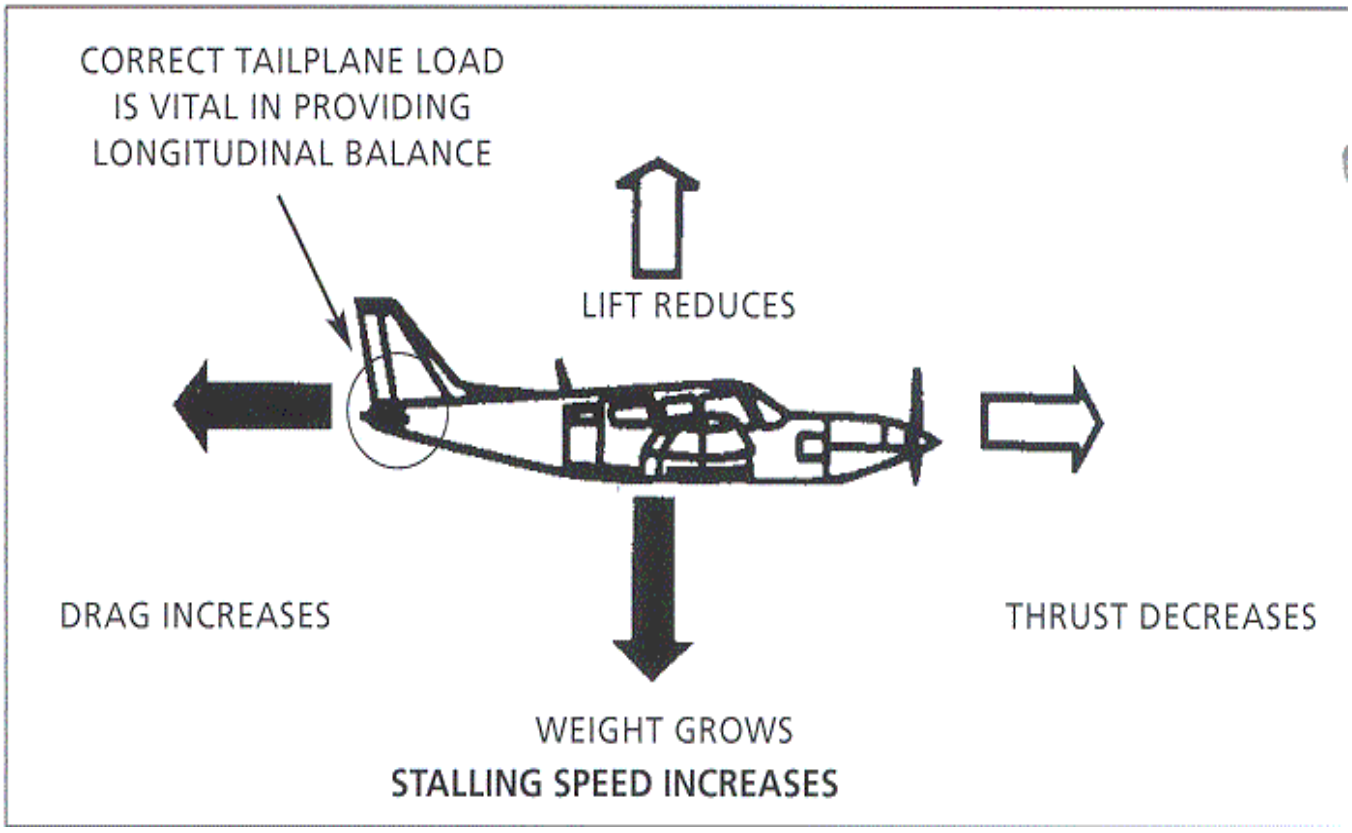
o) Freezing rain can occur during the winter months either at or near the ground, or in a layer at height. It occurs when warm moist air moves into a cold region. This may produce a layer of moist air with a temperature higher than 0°C above a much colder layer with a temperature below 0°C. Precipitation forming in high cloud layers melts into rain as it falls through the warm air. When it falls into the sub-freezing layer and encounters a cold object, it forms a solid layer of clear ice over it. This clear ice will build up very quickly and is difficult to 'shake off'.

p) Freezing rain is the most severe form of airframe icing. It can be encountered in flight up to altitudes of 10,000 feet, or it may occur on the ground or when flying close to the ground. The ice may form rapidly on an aircraft, whether it is parked outside or in flight. If freezing rain is encountered in flight near the ground it is best to land as soon as possible; or if the severe icing is encountered at a higher altitude descend, if possible, into a warmer layer below.

q) If you are in trouble, tell someone clearly and in good time and make sure the transponder is ON and set to code 7700. The Emergency Services can receive a transponder return much better than the primary radar return.

r) Ice forming on an aircraft can cause odd vibrations and noises. An aerial iced up may begin to vibrate (and can fall off). Don't panic, remember **AVIATE, NAVIGATE, COMMUNICATE**.

s) Monitor any autopilot, and be ready to disconnect it. It may have been surreptitiously altering the trim to compensate, possibly, for the effect of an ice build-up.



7 LANDING

a) If on arrival you descend with an iced-up aeroplane and windshield and cannot see, use the DV window. However, it is better to hold off if you can while ice melts than to try to land with restricted visibility.

b) Most icing accidents occur when the pilot loses control during approach or landing. Even a thin coat of ice on the aircraft justifies a 20% increase in approach speed. It will extend the landing run – perhaps on a slippery runway. The handling may be different, don't make large or abrupt changes in power or flap settings.

c) If you suspect, because of changed stick forces or vibration, that there is ice on the tailplane, a flapless or partial flap landing may be advisable (the handbook/manual gives flapless-approach speeds). This reduces the tailplane load and the likelihood of tailplane stall, which can result in a VERY severe pitch down. Recovery is by REDUCING THE FLAP angle and by pulling hard – over 50 kg (110 lb) may be necessary.

d) Another unpleasant surprise due to tailplane ice could be when the aircraft is being flown on autopilot, which has been slowly and silently re-trimming nose-up and reaches the limit. When the flaps are lowered, the autopilot could disconnect and it may require four strong arms to recover. Again, go for the flap selector.

e) When landing on a very wet or icy runway, particularly in a crosswind, the aircraft may aquaplane or slide and directional control can be lost. In such circumstances an alternate runway or diversion is necessary. Aircraft with castoring nosewheels may be more vulnerable.

f) Remember that ground temperatures fall quickly during the late afternoon on an exposed airfield and by dusk ice may be forming on any wet runways. The ice may form as a clear sheet which is invisible and has a coefficient of friction of zero!

g) Helicopter pilots should beware of 'white-out' due to blowing snow when hovering. (See *SafetySense Leaflet No. 17 'Helicopter Airmanship'*.)

8 AFTER FLIGHT

a) Take care when getting out of the aircraft. Jumping from the aircraft walkway onto an icy apron could lead to a painful tumble.

b) If parked outside, use control locks and proper tie-downs to guard against winter gales. Face into the prevailing or forecast wind. Unlike the picture, put proper pitot and static covers on – make sure the pitot has cooled down!

c) If it is muddy or slushy, inspect wheel fairings, landing gear bays, flaps and tailplane for loose mud or slush. These are easier to remove when soft than when frozen.

d) Notify Air Traffic Services if the actual weather was different, or worse, than forecasted. It might be important for other pilots to know.

9 SUMMARY

- Stay out of icing conditions for which the aircraft has NOT been cleared.
- Note freezing level in the aviation weather forecast. Don't go unless the aircraft is equipped for the conditions.
- Have warm clothing available for pre-flight and in case of heater failure or forced landing.
- Mud, snow and slush will lengthen take-off and landing runs. Work out your distances.
- Remove all frost, ice and snow from the aircraft – there is no such thing as a little ice.
- Check carefully that all essential electrical services, especially pitot heat, are working properly.
- Check that the heater and demister are effective. Watch out for any signs of carbon monoxide poisoning.
- Be extra vigilant for carb ice.
- If ice does start to form, act promptly, get out of the conditions by descending (beware of high ground), climbing or diverting.
- If you encounter ice, tell ATC so that others can be warned.
- During the approach if you suspect tailplane ice, or suffer a severe pitch down, RETRACT THE FLAPS.
- If you have to land with an iced up aeroplane, add at least 20% to the approach speed.
- Snow-covered, icy or muddy runways will make the landing run much longer and crosswinds harder to handle.

THERE IS NO SUCH THING AS A LITTLE ICE