Eidg. Departement für Umwelt, Verkehr
Energie und Kommunikation Nr. 1654

Schlussbericht des Büros für Flugunfalluntersuchungen

über den Unfall

des Flugzeuges Piper J-3C-65L-4 (65 PS) HB-OFK
vom 4. August 1997
in Willisau (Mettenberghöhe)/LU

SCHLUSSBERICHT

DIESER BERICHT WURDE AUSSCHLIESSLICH ZUM ZWECKE DER UNFALLVERHÜTUNG ERSTELLT. DIE RECHTLICHE WÜRDIGUNG DER UMSTÄNDE UND URSACHEN VON FLUGUNFÄLLEN IST NICHT SACHE DER FLUGUNFALLUNTERSUCHUNG (ART. 24 DES LUFTFAHRTGESETZES)

LUFTFAHRZEUG Flugzeug Piper J-3C-65L-4 (65 PS) HB-OFK

HALTER Privat

EIGENTÜMER Privat

PILOT Schweizerbürger, Jahrgang 1949

AUSWEIS für Privatpiloten

FLUGSTUNDEN **insgesamt** 201:41 **während der letzten 90 Tage** 30
mit dem Unfallmuster 40:03 **während der letzten 90 Tage** 30

ORT Willisau (Mettenberghöhe)/LU

KOORDINATEN 640 900 / 216 300 **HOEHE** 705 m/M

DATUM UND ZEIT 4. August 1997, 1800 Uhr Lokalzeit (UTC + 2)

BETRIEBSART Privater Rundflug

FLUGPHASE Landung

UNFALLART Notlandung nach Triebwerkstörung

PERSONENSCHADEN

	Besatzung	Passagiere	Drittpersonen
Tödlich verletzt	---	---	---
Erheblich verletzt	---	---	---
Leicht oder nicht verletzt	1	---	

SCHADEN AM LUFTFAHRZEUG Schwer beschädigt

SACHSCHADEN DRITTER Geringer Flurschaden

FLUGVERLAUF

Am Mittwoch, den 4. August 1997 um 1740 Uhr Lokalzeit startete der Pilot in Triengen allein an Bord in der Absicht, im Napfgebiet einen Rundflug durchzuführen; er flog Richtung Entlebuch. Nach seinen eigenen Angaben betrug der Benzinvorrat ca. 30 Liter. Ueber Willisau/Schülen auf ca. 3000 ft verlor der Motor an Leistung und begann zu stottern. Mit der Vergaservorwärmung und Bewegungen am Gashebel versuchte der Pilot, die gesetzte Leistung des Motors wieder zu erreichen, jedoch ohne Erfolg. Der Motor gab immer weniger Leistung ab und kam schliesslich gänzlich zum Stillstand. Da das Muster keine elektrische Startvorrichtung aufweist, bereitete sich der Pilot auf eine Notlandung vor und unternahm keine weiteren Manipulationen mehr. Das für eine Notlandung schwierige Gebiet des Mettenberges flog er in allgemeiner Richtung West an. Im Chanelgraben bietet der an einer Stelle relativ flache Talboden gewisse Möglichkeiten zu einer Notlandung. Die flache Krete des Hügelzuges zwischen Mettenberg und Mörisegg wurde in geringer Höhe überquert. Kurz danach bekam das Flugzeug im sanft abfallenden Gelände in einem Getreidefeld mit dem rechten Flügel Bodenberührung, drehte sich um etwa 180 Grad und kam entgegen der Anflugrichtung zum Stillstand. Der Pilot blieb unverletzt.

BEFUNDE

- Der Pilot war im Besitz eines gültigen Ausweises.

- Es liegen keine Hinweise auf gesundheitliche Störungen des Piloten vor.

- In den letzten 90 Tagen konnte der Pilot ein ausreichendes Training nachweisen.

- Das Flugzeug war zum Verkehr VFR bei Tag zugelassen.

- Masse und Schwerpunkt befanden sich innerhalb der vorgeschriebenen Grenzen.

- Die Zelle wurde am 27.1.97 beim Stand von 2716 Betriebsstunden überholt. Der Motor erfuhr am 9.11.85 eine Generalrevision, wurde anschliessend konserviert und am 8.11.96 in bezug auf Langzeitschäden kontrolliert. Am 25.1.97 fand ein Prüflauf statt und am 7.6.97, nach 25 Betriebsstunden seit Einbau, wurde ein Oelwechsel durchgeführt.

- Die Besichtigung des Flugzeuges zwei Tage nach dem Unfall ergab keine Hinweise auf vorbestandene Schäden, die zum Unfall hätten beitragen können. Das Treibstoffsystem enthielt noch Benzin; Verunreinigungen oder Wasser im Filtergehäuse konnten nicht festgestellt werden. Das Bild der Zündkerzen wies auf eine normale Verbrennung hin.

- Die beiden Magnete wurden einem Prüflauf unterzogen, sie zeigten bei verschiedenen Temperaturen und Drehzahlen ein einwandfreies Verhalten.

- Der Vergaser vom Typ Stromberg wurde, soweit es der Zerstörungsgrad erlaubte, auf Funktionstüchtigkeit hin untersucht und in Ordnung befunden. Der Benzinfilter war sauber und in gutem Zustand.

- Wetter: Leicht bewölkt, Sicht über 10 km, Wind 50 Grad, um 4 kt, Spitzen bis 8 kt. Temperatur/Taupunkt am Boden 26/16 Grad. In einer Höhe von 1000 m/M lag die Temperatur bei ca. 18 Grad und der Taupunkt bei ca. 10 Grad.

BEURTEILUNG

Nach der Triebwerkstörung hat der Pilot in einem schwierigen Gelände und mit wenig Höhenreserve die praktisch einzige Möglichkeit einer Notlandung ausgeschöpft und einen relativ flachen Abschnitt in einem Tal angesteuert. Die Notlandung misslang, weil das Flugzeug früher als beabsichtigt auf einer vorgelagerten Erhöhung der Hügelkette Bodenberührung in einem Getreidefeld bekam.

Das Muster weist, gemäss Erkundigungen bei den wenigen noch im Betrieb stehenden Einheiten in der Schweiz, mit dieser Motorenversion ein empfindliches Verhalten in bezug auf Vergaservereisung auf. Es wurden beispielsweise von einem Piloten bereits beim Rollen unter sommerlichen Temperaturen Vereisungen festgestellt, die zum Motorenstillstand geführt haben. Ein anderer Pilot hat beobachtet, dass 30 Sekunden bis 1 Minute vom ersten Anzeichen eines Stotterns bis zum Abstellen des Triebwerks verstrichen. Der Vergaser vom Typ Stromberg soll sich in dieser Beziehung gegenüber andern Typen noch ausgeprägter verhalten. Unter den herrschenden atmosphärischen Bedingungen kann Vergaservereisung auftreten, sofern der Motor mit einer reduzierten Leistung betrieben und die Vergaservorwärmung nicht frühzeitig genug betätigt wird.

Mit grosser Wahrscheinlichkeit hat der Pilot eine beginnende Vergaservereisung nicht rechtzeitig erkannt, sodass sich in der Folge eine Motorpanne einstellen konnte. Andere technische oder operationelle Gründe für die Triebwerkstörung konnten nicht ermittelt werden.

URSACHE

Der Unfall ist zurückzuführen auf:

- Eine Notlandung als Folge einer Motorpanne, wahrscheinlich ausgelöst durch Vergaservereisung.

Bern, 6. März 1998 Büro für Flugunfalluntersuchungen

6. Summary

- Icing forms stealthily.
- Some aircraft/engine combinations are more susceptible than others.
- Icing may occur in warm humid conditions and is a possibility at any time of the year in the UK.
- Mogas makes carb icing more likely.
- Low power settings are more prone to carb icing.
- Use full carb heat frequently when flying in conditions conducive to carb icing. Remember that the RPM gauge is your primary indication for a fixed pitch propeller; manifold pressure for variable pitch.
- Treat the carb heat as an ON/OFF control – either full hot or full cold.
- It takes time for the heat to work and the engine may run roughly while the ice is clearing.
- Timely use of appropriate procedures can PREVENT THIS PROBLEM.

PREVENTION IS BETTER THAN CURE

Other leaflets in this series:

New leaflets will appear from time to time on a non-regular basis.

This leaflet does not supersede or replace any formal documents.
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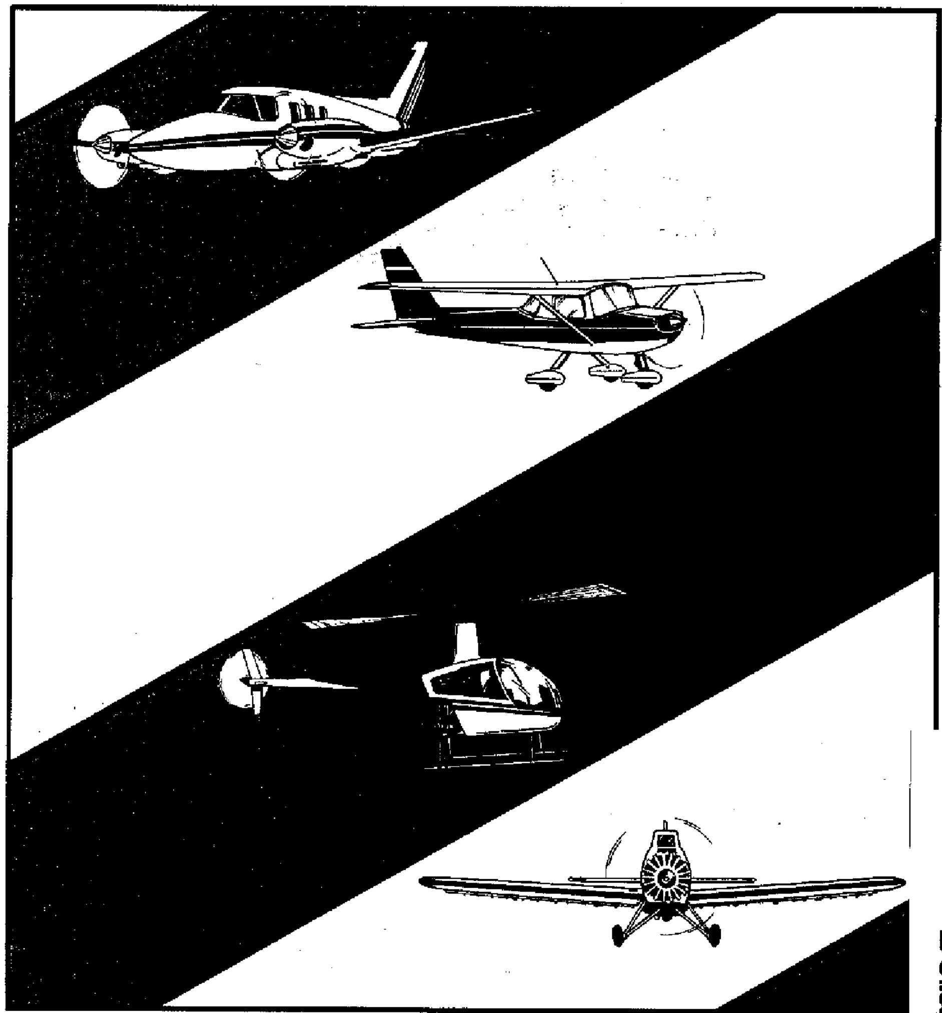
General Aviation Safety Sense



CAA

Beilage

PISTON ENGINE ICING

1. Introduction

a. Piston engine induction system icing, commonly referred to as carburettor icing, can occur even on **warm days, particularly if they are humid.** It can be so severe that **unless** correct action is taken the engine may stop (especially at low power settings during descent, approach or during helicopter autorotation).

b. Every year there are several accidents in the UK where engine induction system icing may have been a factor. Unfortunately the evidence rapidly disappears.

c. Some aircraft/engine combinations are more prone to icing than others and this should be borne in mind when switching to a different aircraft type.

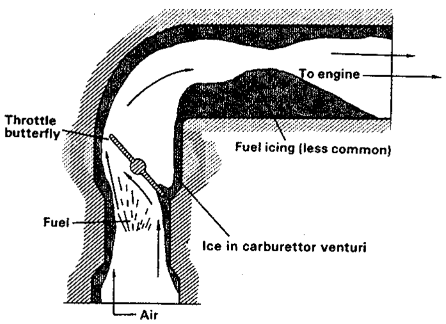
2. Types of Icing

There are three main types of induction system icing:

a. *Carburettor Icing*

The most common, earliest to show, and the most serious, is carb icing caused by the sudden temperature drop due to fuel vaporisation and pressure reduction at the carburettor venturi. The temperature drop of 20–30°C results in atmospheric moisture forming ice which gradually blocks the venturi. This slowly strangles the engine upsetting the fuel/air ratio causing a progressive, smooth loss of power. Conventional float type carburettors are more prone to icing than pressure jet types.

BUILD-UP OF ICING IN INDUCTION SYSTEM



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b. *Fuel Icing*

Less common, is fuel icing which is the result of water, held in suspension in the fuel, precipitating out and freezing in the induction piping, especially in the elbows formed by bends.

c. *Impact Ice*

Ice which builds up on air intakes, filters, alternate air valves etc is known as impact ice. It forms in snow, sleet, sub-zero cloud and rain if either the rain or the aircraft is below zero °C. This type of icing can affect fuel injection systems as well as carburettors. In general, impact ice is the only hazard for turbocharged engines.

d. Testing has shown that because of its greater volatility and possibly higher water content, carb icing is more likely when MOGAS is used.

e. Reduced power settings are more prone to icing because engine temperatures are lower and the partially closed butterfly can more easily be restricted by the ice build-up.

Note: For the sake of simplicity, in the rest of this leaflet the term Carb Icing includes Induction Icing and Carb Heat includes Alternate Air.

3. Atmospheric Conditions

a. Carb icing is **not** restricted to cold weather, and will occur on **warm days** if the **humidity is high,** especially at **low power settings.** Flight tests have produced serious icing at descent power with the ambient (not surface) temperature over 25°C, even with relative humidity as low as 30%. At cruise power, icing occurred at 20°C when the humidity was 60% or more. (Cold, clear winter days are less of a hazard than humid summer days because warm air will hold more moisture than cold air.) In the United Kingdom and Europe where high humidity is common, pilots must be constantly on the alert for the possibility of carb icing and take corrective action **before** an irretrievable situation arises. If there is an engine failure due to carb icing, the engine may not re-start and even if it does, the delay could be critical.

b. Carb icing will occur even in clear air and is therefore more dangerous due to the lack of visual warning. In cloud the risk of icing may be higher but the pilot is **less** likely to be taken unawares.

c. Specific warnings of induction system icing are not included in standard weather forecasts for aviation and you must be prepared to deal with it on the basis of your knowledge and experience. When dewpoint information is not available, assume high humidity particularly when:

— the surface and low level visibility is poor, especially in the early morning and late evening, and particularly when near a large area of water;

— the ground is wet (even with dew) and the wind is light;

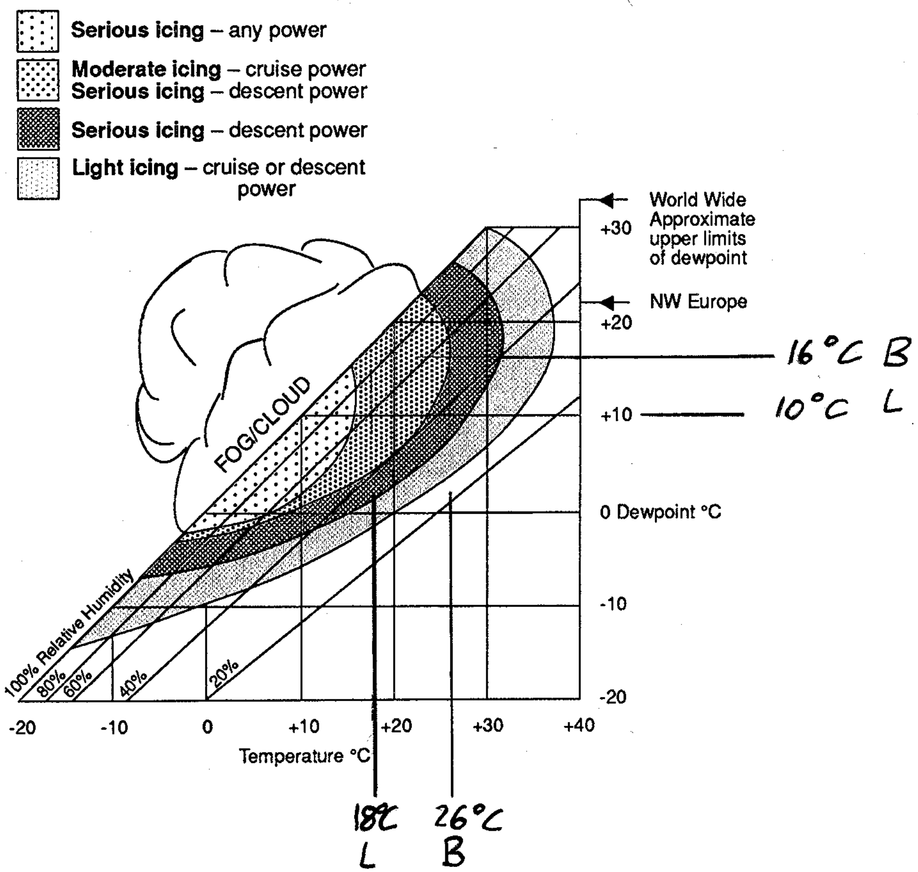
— just below cloud base or between cloud layers (highest liquid water content is at cloud tops);

— in precipitation, especially if persistent;

— in clear air where cloud or fog have just dispersed;

— in cloud and fog, these being water droplets; hence the relative humidity should be assumed to be 100%.

d. The chart below shows the wide range of ambient conditions conducive to the formation of carb icing. Particular note should be taken of the much greater risk of serious icing with descent power. The closer the temperature and dewpoint readings, the greater the humidity.



4. Recognition and General Practices

Paragraphs 4 and 5 are intended as a general guide to assist you to avoid icing, but reference should be made to the relevant sections of Pilot's Operating Handbook or Flight Manual for specific procedures related to the particular airframe/engine combinations. **These may vary for a different model of the same aircraft type.**

a. With a fixed pitch propeller, a slight drop in rpm and airspeed are the most likely indication of the onset of carb icing. This **loss of rpm** can be smooth and gradual and the usual reaction is to open the throttle slightly to compensate (making matters worse). As the icing builds up, rough running, vibration, loss of airspeed and ultimately stoppage of the engine may follow. The main detection instrument is the **rpm gauge** in conjunction with the ASI.

b. With a constant speed propeller, and in a helicopter, the loss of power would have to be large before a reduction in rpm occurs. Onset of icing is even more insidious, but the effects will be a **drop in manifold pressure** and reduction in airspeed in level flight. Thus, in this case the main detection instrument is the **manifold pressure gauge.**

c. An exhaust gas temperature gauge will show a noticeable decrease in temperature before any significant decrease in engine and aircraft performance.

d. Carb icing is removed by the pilot selecting an alternative air source which supplies hot air, (heated in an exhaust heat exchanger)*. This source by passes the normal intake filter. Thus hot air melts the ice obstruction.

e. Engines with fuel injection generally have an alternate air intake located within the engine cowling via a valve downstream from the normal air intake. This alternate air is warmed somewhat by engine heat, even though it does not pass through a heat exchanger.

f. Use **full** heat whenever carb heat is applied, partial hot air should only be used if an intake temperature gauge is fitted and only then in accordance with the Flight Manual or Pilot's Operating Handbook. Partial heating can induce carb icing because it may melt impact ice particles (which would otherwise pass into the engine without causing trouble) but **not** prevent the resultant mixture from freezing when it passes through the induction system; or it can raise the air temperature into the critical range.

g. Other than on take-off, hot air should be selected whenever a drop in rpm or manifold pressure is experienced. When icing conditions are suspected or when flying in conditions within the high probability ranges indicated in the chart at paragraph 3(d). Unless expressly permitted, (or necessary), **the continuous use of hot air should** be avoided. It should be selected intermittently for long enough to pre-empt the loss of engine power or restore the engine power to the original level.

h. If a loss of power is due to icing, and the use of hot air disperses it, re-selection of cold air **should** produce an increase in rpm or manifold pressure over the earlier reading. This is a useful check to see whether ice is forming. If it is, keep an eye on the engine instruments as it may re-occur. Lack of carb icing will mean that there will be no increase in rpm or manifold pressure beyond those noted prior to the use of hot air.

i. Remember, selection of hot air when ice is present may at first make the situation appear worse due to an increase in rough running as the ice melts and passes through the engine. If this happens the **temptation to return to cold air must be resisted** so that the hot air has time to clear the ice. **This time may be in the region of 15 seconds,** which will in the event feel like a very long time!

5. Pilot Procedures

a. *Maintenance*

Periodically check the carb heating system and controls for proper condition and operation. Pay particular attention to the condition of seals which may have deteriorated allowing the hot air to become diluted by cold air.

b. *Start Up*

Start up with the carb heat control in the **COLD** position.

c. *Taxying*

Generally, the use of carb heat is not recommended while taxying because the air is usually unfiltered when in the HOT position.

*Design Requirements typically demand a temperature rise of 50°C at 75% power.

d. *Ground Run-Up*

Check that there is a **significant** power decrease when hot air is selected (typically 75–100 rpm and 3–5" of manifold pressure) and that power is regained when cold air is re-selected. If it is suspected that icing is present, the hot position should be selected until the ice has cleared and full power is restored.

e. *Immediately Prior to Take-Off*

Since icing can occur when taxying with small throttle settings, or when the engine is idling, select carb heat ON for 5 seconds and then OFF, immediately before take off to remove any build-up. If the aircraft is kept waiting at the holding point in conditions of high humidity it may be necessary to carry out the run-up drill more than once to clear ice which may have formed. Take-off should **only** be commenced when you are sure the engine is developing full power.

f. *Take-Off*

When at full power, you should make a quick check that the full throttle rpm and/or manifold pressure are as expected. **Carburettor heat must NOT be used during take-off** unless specifically authorized in the Flight Manual or Pilots Operating Handbook.

g. *Climb*

Be alert for symptoms of carb icing, especially when visible moisture is present or if conditions are in the high probability ranges of para 3(d).

h. *Cruise*

Monitor appropriate engine instruments for a slow decline. Make a carb heat check at least every 10 minutes, (more frequently if conditions ar conducive to icing). Use **full heat** and note the warning of para 4 (e), it may take up to 15 seconds to clear the ice and the engine will continue to run roughly as the ice melts and passes through the engine. If the icing is so severe that the engine has died, keep the hot air selected as any residual heat in the rapidly cooling exhaust **may** restore power. If impact ice is encountered it is vital to select carb heat before the selector valve is frozen solid by an accumulation of ice around it. Avoid clouds as much as possible, note that hardly any piston engined aircraft are cleared for flight in icing conditions.

i. *Descent and Approach*

As reduced power is much more conducive to carb icing, it is advisable to select hot air **before, rather than after,** power is reduced for the descent, or an autorotation, ie, before the exhaust starts to cool. (This also allows a check that the carb heat is still working.) Maintain **FULL** heat during long periods of flight with reduced power settings. At intervals of about 500 ft increase power to cruise setting to warm the engine and to provide sufficient heat to melt any ice.

j. *Downwind*

Ensure that the downwind check includes the following check:

— Note the RPM/Manifold Pressure

— Apply Full Carb heat for about 15 seconds and note the reduced indication.

— Return Carb heat to Cold. The RPM/ Manifold Pressure should return to the earlier indication. If it is higher – icing was present.

k. *Base Leg and Final Approach*

Unless otherwise stated in the Pilot's Operating Handbook or Flight Manual, the HOT position should be selected on base leg when power is reduced. On some engine installations, to ensure better engine response and to permit a go-around to be initiated without delay, it is recommended that the carb heat should be selected to COLD at about 200/300 ft on finals.

l. *Go-around or Touch and Go*

Ensure the carb heat is COLD, ideally before or immediately after power is applied for a go-around.

m. *After Landing*

Return to the COLD setting before taxying.

THE SUMMARY IS OVERLEAF