AAIB Bulletin No: 2/2005 **Ref: EW/G2004/10/03** **Category: 2.3**

Aircraft Type and Registration:	Robinson R22 Beta, G-BYTD	
No & Type of Engines:	1 Lycoming O-360-J2A piston engine	
Year of Manufacture:	1999	
Date & Time (UTC):	13 October 2004 at 0845 hrs	
Location:	Between Brafield and Hackleton, near Sywell, Northants	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - None
Injuries:	Crew - Minor	Passengers - N/A
Nature of Damage:	Aircraft destroyed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	50 years	
Commander's Flying Experience:	77 hours (all on type) Last 90 days - 5 hours Last 28 days - 1 hour	
Information Source:	Aircraft Accident Report Form submitted by the pilot	

History of flight

The pilot took off from Sywell Aerodrome at about 0830 hrs on a solo flight. The pilot recalled checking the carburettor temperature gauge on leaving the airfield's air traffic zone and seeing that it was indicating above the yellow avoid arc. He nevertheless decided to apply still more carburettor heat to ensure the gauge needle indicated well clear of the yellow arc.

The pilot estimates he had been flying at 2,000 feet amsl and 80 kt for approximately ten minutes when he decided to descend to 1,500 feet amsl. As the aircraft approached 1,600 feet amsl the pilot started to level off, at which point he reported the tail of the aircraft began to swing violently left and right. Attempts to get the aircraft flying straight only seemed to make the problem worse and the aircraft quickly lost altitude.

Unable to rectify the problem the pilot decided to make a forced landing and turned the aircraft into wind whilst trying to identify a suitable landing site. He reduced the aircraft's speed from 80 kt whilst still trying to prevent it yawing from side to side and descended towards some fields he had

identified. When at treetop height the pilot managed to straighten the aircraft in anticipation of doing a run-on landing; however, he then found himself heading straight for a tree in a hedgerow, which he just managed to avoid. Straightening the aircraft again he passed low over the hedgerow before touching down in the field beyond it at an estimated speed of 40 kt. The field had recently been cultivated and presented a flat smooth surface on which to land, although the surface was also soft.

Pictures submitted of the accident site suggest the aircraft touched down heavily on its right skid first before touching down on the left skid. The aircraft ran on with sufficient force to break the skids off the aircraft at this point. Impact marks also indicate one of the rotors then hit the ground and that the aircraft rolled over, causing considerable damage and shattering the canopy, before finally coming to rest lying on its right-hand side about 15 metres beyond the impact marks left by the skids.

The pilot reported passing out at about the point the aircraft rolled over and then regaining consciousness to discover fuel pouring out of the aircraft. He managed to vacate the aircraft through the broken canopy and then make his way to a roadside to summon help.

Carburettor heating system description

The aircraft involved in the accident was fitted with a manually selected carburettor heater and an additional carburettor heat assist device. A gauge on the instrument panel displayed the carburettor temperature and contained a yellow arc indicating the temperature range to be avoided. Below this gauge were the words:

"CAUTION BELOW 18 IN. MP, IGNORE GAGE (sic) *& APPLY FULL CARB HEAT"*

The section of the aircraft flight manual relating to the use of carburettor heat on the aircraft is reproduced on the next page.

The Civil Aviation Authority issued supplementary instructions on the use of the Carb Heat Assist (CAA Change Sheet No. 4 Issue 4 Ref RTR061 dated 1 August 2001). This instruction called for the following words to be inserted into the flight manual:

> *"The Carb Heat Assist does not apply automatically the correct amount of carb heat to keep the CAT gage needle out of the yellow arc at all flight conditions. The pilot must monitor the CAT gage, and manually apply carb heat as required. Following a large power change, especially a lowering and raising of collective, the CAT gage must be checked, as the original datum may have been lost.*
>
> *Before entering a descent or auto-rotation, FULL carb heat must be selected."*

USE OF CARBURETOR HEAT

When conditions conducive to carburetor ice are known or suspected to exist, such as fog, rain, high humidity, or when operating near water, use carburetor heat as follows:

At power settings above 18 inches MAP, apply carburetor heat as required to keep CAT gage needle out of yellow arc.

At power settings below 18 inches MAP, ignore gage and apply full carburetor heat (CAT gage does not indicate correct carburetor temperature below 18 inches MAP).

CAUTION

The pilot may be unaware of carburetor ice formation as the governor will automatically increase throttle and maintain constant manifold pressure and RPM. Therefore, the pilot must apply carburetor heat as required whenever icing conditions are suspected.

USE OF CARB HEAT ASSIST

A carburetor heat assist device is installed on R22s with O-360 engines. The carb heat assist correlates application of carburetor heat with changes in collective setting to reduce pilot work load. Lowering collective mechanically adds heat and raising collective reduces heat. Collective input is transmitted through a friction clutch which allows the pilot to override the system and increase or decrease heat as required. A latch is provided at the control knob to lock carburetor heat off when not required. It is recommended that the control knob be unlatched (to activate carb heat assist) whenever OAT is between 80°F (27°C) and 25°F (-4°C) and the difference between dew point and OAT is less than 20 F° (11 C°). Readjust carburetor heat as necessary following any change in power.

Aircraft Flight Manual Extract

Analysis

The air temperature at the surface and the dew point for the area at the time the aircraft was airborne were about 12°C and 9°C respectively, which gave a humidity of between 82% and 87%. Meteorological reports also indicated some cloud cover at 1,200 to 1,500 feet amsl, which would indicate higher humidity at that level. From the chart reproduced at the end of this report, it can be seen that these conditions are likely to cause serious carburettor icing, regardless of the power selected, if adequate carburettor heating is not applied.

Although the pilot stated he had applied some carburettor heating whilst airborne, had the temperature gauge not been regularly monitored it is possible that carburettor icing might have started to build up during the flight at 2,000 feet amsl. Whether or not this was the case, the pilot also stated he could not remember whether he had selected full carburettor heat before entering the descent. If he did not do so, it is highly likely that carburettor icing would have formed during the descent.

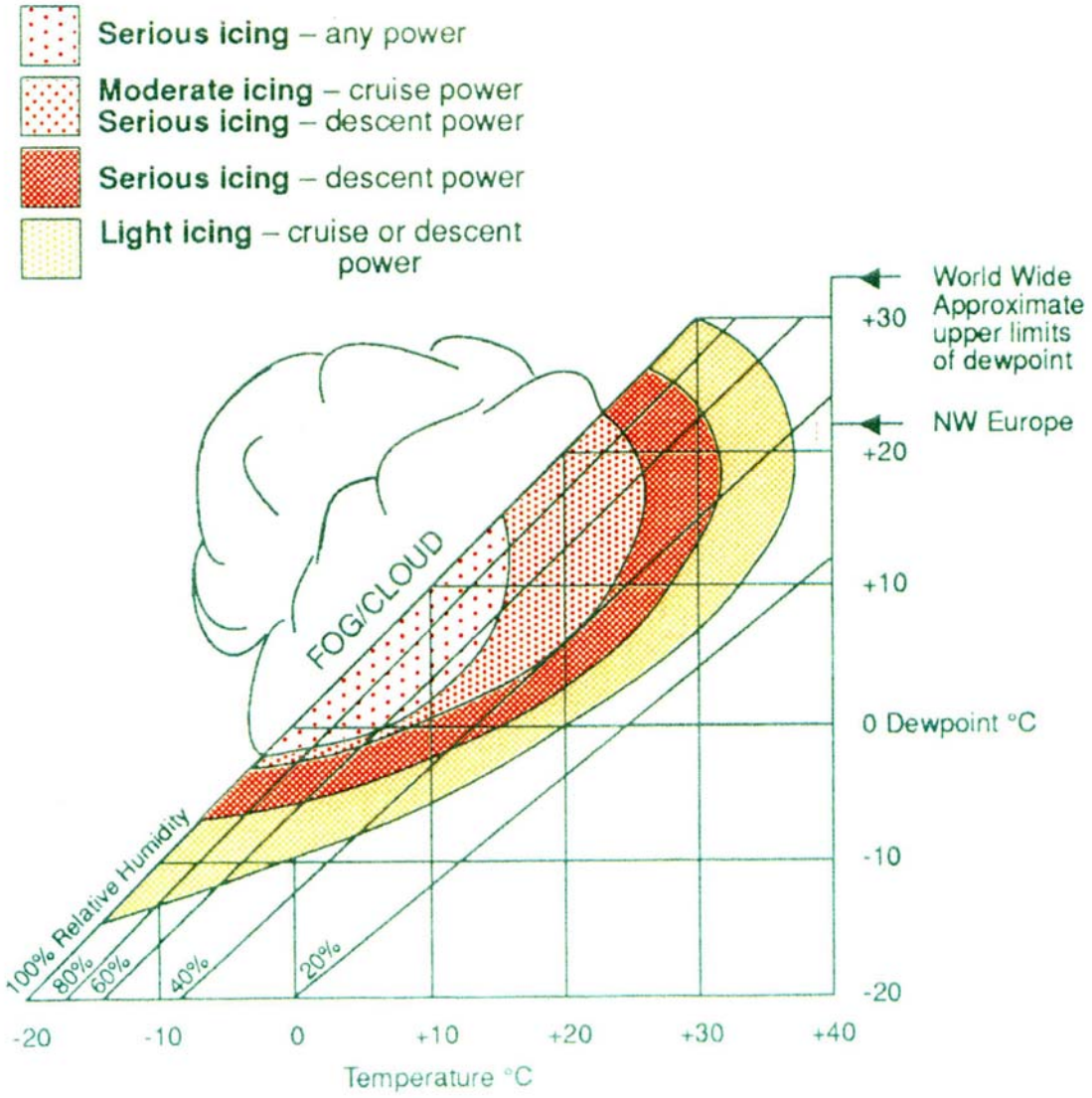
Either or both scenarios would have lead to the engine governor trying to compensate for the loss of power by increasing the fuel flow until it could not increase it any further. At this point the governor would 'hunt', increasing and reducing the fuel flow in an attempt to regulate the rotor RPM. These fluctuations would have caused the torque to increase and decrease as the power changed, leading in turn to the aircraft yawing from side to side. Due to the alternating direction of the yaw it is possible that an inexperienced pilot might, in an attempt to correct the yaw, exacerbate the situation by entering into a form of pilot induced oscillation.

Conclusion

From the pilot's description and the weather present in the area at the time it is likely that insufficient carburettor heat was applied, especially during the aircraft's descent, leading to a build up of carburettor ice. The relative inexperience of the pilot, together with the effects of the governor, made it difficult for him to recognise the situation he was in. Under the circumstances it is understandable that he wished to make a forced landing. However, again, his relative inexperience lead to difficulties in controlling the aircraft and resulted in a heavy and fast run-on landing.

More information on Robinson R22 carburettor icing is available for downloading from the website: www.morningtonsanfordaviation.co.uk under the heading 'No Ice, Thank You!'

CARB ICING


Serious icing – any power
Moderate icing – cruise power
Serious icing – descent power
Serious icing – descent power
Light icing – cruise or descent power
World Wide Approximate upper limits of dewpoint
NW Europe
FOG/CLOUD
100% Relative Humidity
80%
60%
40%
20%
+30
+20
+10
0 Dewpoint °C
-10
-20
-20
-10
0
+10
+20
+30
+40
Temperature °C