

Log 2470



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 25, 1994

In reply refer to: A-94-137 and -138

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On November 21, 1992, about 0935 Pacific standard time, a Beechcraft Duke Model A60, N100EK, crashed about 2 miles west of Snoqualmie Pass, Washington. The pilot and five passengers aboard were killed, and the airplane was destroyed. The airplane had departed Boeing Field/King County International Airport at 0917 on an instrument flight rules flight plan and was climbing to 17,000 feet mean sea level (msl) in moderate, mixed icing conditions shortly before the accident. A performance study by the National Transportation Safety Board, based on recorded radar data, winds aloft, and other information, disclosed that the airplane's indicated airspeed during climb ranged from 82 to 123 knots. After passing through approximately 13,500 feet, the airplane experienced two abrupt altitude excursions and then entered a steep descending left turn. During the descent, the airplane accelerated to a speed in excess of the "never-exceed speed" (V_{ne}), sustained an in-flight failure of the airframe, and struck the ground in a near vertical attitude. The Safety Board has determined that weather conditions (including icing) and loss of engine power may have contributed to the accident. Several pilots who had flown in the area that morning indicated that they had experienced a relatively rapid accumulation of ice in clouds from 3,000 to 21,000 feet.

On October 29, 1980, a Beechcraft Duke Model A60, N7578D, was involved in a loss of control incident in icing conditions near Leaksville, Mississippi. The airplane, cleared to flight level 210, was climbing at about 100 knots indicated airspeed with the autopilot engaged. At about 19,600 feet msl, according to the pilot, the airplane developed a violent vibration, pitched down, and rolled rapidly to the left. He stated that during the attempt to recover control of the aircraft, excessive resistance to aft and right control wheel inputs was encountered. He further stated that aircraft control was temporarily regained at 14,000 feet, but that a similar vibration was experienced and he again lost control of the airplane. When control of the airplane was finally established, the altimeter indicated approximately 2,000 feet msl. The aircraft was subsequently landed at Mobile, Alabama. Upon exiting the airplane, the pilot noted that the right elevator outboard hinge bracket had separated and the outboard portion of the right elevator

was bent down approximately 90°.

Beechcraft Duke Models 60 and A60 were produced from 1968 to 1973 while the Duke Model B60 was produced from 1974 to 1982. The Safety Board is unaware of any accidents in icing conditions involving the Duke Model B60. However, two other accidents involving Duke Model 60 airplanes in icing conditions have claimed the lives of 14 other persons. These accidents occurred near Jackson, Mississippi, on November 6, 1978, (N135D) and at Hatch, Utah, on January 20, 1974, (N35D).

A review of the Beechcraft Duke Model 60 and A60 Pilot's Operating Handbook/Airplane Flight Manual (POH/AFM), including the FAA-approved sections, disclosed no specification or precautionary performance advisory regarding the appropriate minimum airspeed to maintain while operating in sustained icing conditions. Nor was there any discussion of the potential hazards of operating at relatively low airspeeds in these conditions. However, the Beechcraft pamphlet "Beechcraft Twin Engine (Piston) Airplane Safety Information," which does provide this and other information, has been incorporated in its entirety as an integral part of the Duke Model B60 POH/AFM. The importance of maintaining an appropriate minimum airspeed in the Duke 60 series airplanes during flight in icing conditions and the hazards of ice accumulating on unprotected areas of the airplane is emphasized and explained in the following excerpt from the Beechcraft safety information pamphlet:

Every pilot of a properly fully-equipped Beech airplane who ventures into icing conditions must maintain the minimum speed (KIAS) for operating in icing conditions, which is set forth in the Normal Procedures Section, and in the Limitations section, of his Pilot's Operating Handbook and FAA Approved Airplane Flight Manual. If a minimum speed for flight in icing conditions is not specified in the manual, the following indicated airspeeds must be maintained:

All Baron and Travel Air Models - 130 KIAS

All other BEEHCRAFT twin-engine models - 140 KIAS

The pilot must remain aware of the fact that if he allows his airspeed to deteriorate below this minimum speed, he will increase the angle of attack of his airplane to the point where ice may build up on the under side of the wings aft of the area protected by the boots.

The fact or extent of ice build-up in unprotected areas will not be directly observable from the cockpit. Due to distortion of the wing airfoil, increased drag and reduced lift, stalling speeds will increase as ice accumulates on the airplane. For the same reasons, stall warning devices are not accurate and cannot be relied upon in icing conditions.

Even though the pilot maintains the prescribed minimum speeds for operating in icing conditions, ice is still likely to build up on the unprotected areas (the fuselage and

unprotected wing leading edge inboard of the engine nacelle). Under some atmospheric conditions, it may even build up aft of the boots despite the maintenance of the prescribed minimum speed. The effect of ice accumulation on any unprotected surface is aggravated by length of exposure to the icing conditions. Ice buildup on unprotected surfaces will increase drag, add weight, reduce lift, and generally, adversely affect the aerodynamic characteristics and performance of the airplane. It can progress to the point where the airplane is no longer capable of flying. Therefore, the pilot operating even a fully-equipped airplane in sustained icing conditions must remain sensitive to any indication, such as observed ice accumulation, loss of airspeed, the need for increased power, reduced rate of climb, or sluggish response, that ice is accumulating on unprotected surfaces and that continued flight in these conditions is extremely hazardous, regardless of the performance of the deicing/anti-icing equipment.

The en route climbout of N100EK was conducted at airspeeds 17 to 58 knots lower than the minimum airspeed for flight in icing conditions recommended by the manufacturer. The reduced airspeeds would have required that the airplane's angle of attack (AOA) be increased substantially - to as much as three and one-half times the AOA required at the prescribed 140 knot minimum airspeed. The Beechcraft Duke 60 series AFM supplement for flight in known icing conditions advises waiting until 1/2 to 1 inch of ice has accumulated before cycling the surface deice system (deice boots). This may be misleading since it is equally important for the pilot to be aware of the airplane's AOA and the potential hazard of ice accumulating on the underside of the wing aft of the deice boots and on other unprotected surfaces of the airplane. Moreover, ice that forms on the empennage may be several times thicker than accumulated wing ice, may exist even when no ice is visible on the wing and, under certain conditions, may be incapable of being cleared. A residual ice accumulation on critical sections of the empennage could result in a tailplane stall.

On March 27, 1980, a Beechcraft Model BE-200 Super King Air, N456L, crashed near Parker, Colorado, shortly after encountering severe icing conditions during an enroute climb to altitude. All 10 persons aboard were killed. The accident prompted a Safety Board review of the flight manuals for several other airplanes certified for flight in known icing conditions, and revealed that none contained any explicit operating specifications to prevent the accumulation of ice on critical, unprotected areas of the airplane. Subsequently, on September 7, 1982, the Safety Board issued the following recommendation to the Federal Aviation Administration:

Amend FAA-approved flight manuals, where applicable, to prescribe minimum airspeeds and appropriate flight precautions during flight in icing conditions. (Class, II, Priority Action)(A-82-118)

On September 2, 1986, the FAA, in response to this recommendation, issued Advisory Circular (AC) No. 23.1419-1 "Certification of Small Airplanes for Flight in Icing Conditions." Although the AC recommends that all AFMs contain procedures to optimize operation of the airplane during icing conditions, including climb, holding and approach configurations, and

speeds, the AC is neither mandatory nor regulatory in nature. As a result, the POH/AFMs applicable to Beechcraft Duke Models 60 and A60, and many other aircraft, still do not contain this essential information.


Since October 1986, small general aviation airplanes operated under 14 CFR Parts 91 and 135 have been involved in 154 accidents that occurred during flight in icing conditions. The icing conditions, which were determined to be either a direct cause or an important factor contributing to the accidents, precipitated a variety of accident occurrences including loss of engine power, in-flight loss of control, in-flight structural failure, and in-flight collision with the terrain. A detailed review of these accidents prompts the Safety Board to believe that a significant number of them might have been prevented if the pilots had been more knowledgeable regarding the various ramifications of an icing encounter, for example, if they had been better informed regarding aircraft performance degradation due to ice, the hazards of an ice-induced tailplane stall, and the limited capability of aircraft certified for flight in icing conditions to provide protection against freezing rain, freezing drizzle, and mixed icing conditions.

Therefore, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that all pilot operating handbooks/airplane flight manuals applicable to aircraft certified for flight in icing conditions contain precautionary operational information to help ensure that ice will not accumulate on the undersurface of the wing aft of the area protected by the deicer boots or on other unprotected areas of the airplane. The information should include specification of a minimum indicated airspeed that should be maintained during sustained operations in icing conditions. (Class II, Priority Action)(A-94-137)

Issue an Advisory Circular (AC) concerning the flight of small general aviation airplanes in icing conditions. The AC should contain current technological/operational information aimed at helping pilots minimize the potential hazards of an icing encounter and include specific explanatory material related to the importance of maintaining an appropriate minimum airspeed during sustained flight in icing conditions; the hazards of an ice-induced tailplane stall; the effects of flap extension and airspeed on an ice-contaminated airplane; aircraft performance degradation due to icing because of increased drag and stalling speeds; the relatively high ice collection efficiency of tailplane surfaces; ways and means of reliably determining the existence and extent of tailplane icing; and the limitations of aircraft certified for flight in icing conditions to provide protection against freezing rain, freezing drizzle, and mixed icing conditions. (Class II, Priority Action)(A-94-138)

Acting Chairman HALL, and Members LAUBER, HAMMERSCHMIDT, and VOGT concurred in these recommendations.


By: Jim Hall
Acting Chairman

Brief of Accident

File No. - 1043 11/21/92 SNOQUALMIE PASS, WA A/C Reg. No. N100EK Time (Lcl) - 0935 PST

---Basic Information---
Type Operating Certificate-NONE (GENERAL AVIATION)

Type of Operation -PERSONAL
Flight Conducted Under -14 CFR 91
Accident Occurred During -DESCENT

Aircraft Damage DESTROYED
Fire ON GROUND
Crew Pass
Fatal 1
Serious 0
Minor 0
Injuries None
None 0

---Aircraft Information---
Make/Model - BEECH A60
Landing Gear - TRICYCLE-RETRACTABLE
Max Gross Wt - 6725
No. of Seats - 6

Eng Make/Model - LYCOMING TIO-541-E1C4
Number Engines - 2
Engine Type - RECIP-FUEL INJECTED
Rated Power - 380 HP

ELT Installed/Activated - YES/YES
Stall Warning System - YES

---Environment/Operations Information---

Weather Data
Wx Briefing - FSS
Method - TELEPHONE
Completeness - FULL
Basic Weather - IMC
Wind Dir/Speed- 100/017 KTS
Visibility - .125 SM
Lowest Sky/Ceiling - UNK/NR
Obstructions to Vision- FOG
Precipitation - SNOW
Condition of Light - DAYLIGHT

Itinerary
Last Departure Point
SEATTLE, WA
Destination
PULLMAN, WA

Airport Proximity
OFF AIRPORT/STRIP
Airport Data

Runway Ident - N/A
Runway Lth/Wid - N/A
Runway Surface - N/A
Runway Status - N/A

ATC/Airspace
Type of Flight Plan - IFR
Type of Clearance - IFR
Type ApcH/Lndg - NONE

---Personnel Information---
Pilot-In-Command
Certificate(s)/Rating(s)
COMMERCIAL
SE LAND, ME LAND, SE SEA

Age - 48
Biennial Flight Review - UNK/NR
Current - UNK/NR
Months Since - UNK/NR
Aircraft Type - UNK/NR
Medical Certificate - VALID MEDICAL-WAIVERS/LIMIT
Flight Time (Hours)
Total - 3250
Last 24 Hrs - UNK/NR
Make/Model- UNK/NR
Instrument- UNK/NR
Last 30 Days- 3
Last 90 Days- 7
Rotorcraft - UNK/NR
Multi-Eng - 1390

Instrument Rating(s) - AIRPLANE

---Narrative---
WHILE CLIMBING IN MOD ICING CONDS AFTER TAKEOFF, PLT WAS CLEARED TO 17,000'. RADAR DATA SHOWED ACFT CLIMBED AT AN INDCD AIRSPEED (IAS) OF 82 TO 123 KTS. A BEECH SAFETY INFO BOOKLET STATED THAT A MIN AIRSPEED OF 140 KTS MUST BE MAINTAINED IN ICING CONDS. CLIMBING AT REDUCED AIRSPEED WOULD HAVE INCREASED ANGLE OF ATTACK & ALLOWED ICE TO ACCUMULATE UNDER THE WINGS & AFT OF THE DE-ICING BOOTS. ACFT CLIMBED TO 13,500', DESCENDED MOMENTARILY TO 13,300', THEN CONTINUED CLIMBING AS AIRSPEED DECREASED ABRUPTLY. AFTER SLOWING TO 60 KTS IAS AT 13,700', THE ACFT ENTERED A STEEP DESCENDING TURN & ACCELERATED TO HIGH SPEED (ABOVE VNE). AN EMERGENCY WAS DECLARED, STATING THE AIRCRAFT "LOST AN ENGINE." SOON THERE-AFTER, RADAR CONTACT WAS LOST & THE ACFT CRASHED. PIECES OF EMPENNAGE SURFACES SEPARATED IN FLIGHT & WERE FOUND AT REMOTE LOCATION FROM THE MAIN WRECKAGE. BOTH COUNTERWEIGHTS SEPARATED FROM THE ELEVATORS. POST-CRASH TESTS DISCLOSED NO MECHANICAL EVIDENCE OF ENGINE MALFUNCTION. LOW CEILING, FOG, LIGHT RAIN, SNOW & ICING CONDITIONS WERE RPTD IN AREA.

Brief of Accident (Continued)

File No. - 1043

11/21/92

SNOQUALMIE PASS, WA

A/C Reg. No. N100BK

Time (Lcl) - 0935 PST

Occurrence #1 IN FLIGHT ENCOUNTER WITH WEATHER
Phase of Operation CLIMB - TO CRUISE

Finding(s)

1. WEATHER CONDITION - FOG
2. WEATHER CONDITION - RAIN
3. WEATHER CONDITION - SNOW
4. WEATHER CONDITION - ICING CONDITIONS
5. AIRSPEED - IMPROPER -
6. WING - ICE

Occurrence #2 LOSS OF ENGINE POWER
Phase of Operation CLIMB

Finding(s)

7. REASON FOR OCCURRENCE UNDETERMINED

Occurrence #3 LOSS OF CONTROL - IN FLIGHT
Phase of Operation CLIMB

Finding(s)

8. AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND

Occurrence #4 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation DESCENT - UNCONTROLLED

Finding(s)

9. AIRSPEED (VNE) - EXCEEDED - PILOT IN COMMAND
10. DESIGN STRESS LIMITS OF AIRCRAFT - EXCEEDED - PILOT IN COMMAND
11. HORIZONTAL STABILIZER SURFACE - OVERLOAD

Occurrence #5 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

Finding(s)

12. TERRAIN CONDITION - MOUNTAINOUS/HILLY

-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident was:
FAILURE OF THE PILOT TO MAINTAIN CONTROL OF THE AIRCRAFT, HIS FAILURE TO PREVENT THE AIRCRAFT FROM EXCEEDING THE NEVER EXCEED SPEED (VNE), AND SUBSEQUENT EXCEEDING OF THE DESIGN STRESS LIMITS OF THE AIRCRAFT. FACTORS RELATED TO THE ACCIDENT WERE: WEATHER CONDITIONS (INCLUDING ICING CONDITIONS), IMPROPER AIRSPEED, AND LOSS OF ENGINE POWER FOR UNDETERMINED REASON(S).