Transportation Safety Board of Canada
Bureau de la sécurité des transports du Canada

REASSESSMENT OF THE RESPONSES FROM THE FEDERAL AVIATION ADMINISTRATION TO AVIATION SAFETY RECOMMENDATION A06-03

CESSNA 208 OPERATION INTO ICING CONDITIONS

Background

On 06 October 2005, a Cessna 208B, registration C-FEXS, operated by Morningstar Air Express as Flight MAL8060, departed Winnipeg, Manitoba, at 0537 central daylight time on an instrument flight rules (IFR) freight flight to Thunder Bay, Ontario. The aircraft, with one pilot and about 2470 pounds of cargo on board, departed Runway 36, climbed, and turned right on course. About 4.5 nautical miles (nm) southeast of the airport, the pilot requested an immediate return to the airport due to icing considerations, but did not declare an emergency. Departure control provided an initial radar vector to Runway 31, and the aircraft turned to a southwesterly heading. A second vector was provided and the pilot responded; however, the aircraft did not turn and descended below radar coverage. The aircraft departed controlled flight and crashed on railway property in the city of Winnipeg. The pilot was fatally injured. The aircraft was destroyed by impact forces and a post-impact fire. The accident occurred during hours of darkness at 0543.

The information gathered to date suggests that in-flight airframe icing was a factor in the occurrence. As well, the pilot cited aircraft icing when asking air traffic control for a clearance to return to Winnipeg. Furthermore, icing conditions were forecast, and were experienced by other aircraft operating in the Winnipeg area at the time of the occurrence.

A review of aircraft performance data and the occurrences involving the Cessna 208 aircraft type indicates that it is more significantly affected by atmospheric icing than some other types of Cessna turbopropeller aircraft certified for flight into known icing conditions. The aircraft's speed does not provide it with much benefit from the effects of friction and compression. In addition to the aircraft's fuselage and empennage, the aircraft design incorporates fixed landing gear, wing struts and a cargo pod. The manufacturer's data indicate that, with residual icing on exposed aircraft surfaces, the aircraft's cruising speed decreases to a point approaching that of the stall speed. Moderate icing conditions require aircraft ice protection systems to operate with a degree of efficiency that allows the aircraft to either operate in those conditions, or to maintain altitude and a safe airspeed for sufficient time that a diversion out of those conditions can be effected. Light icing conditions reduce the demands on ice protection systems and increase the time available for diversions into more benign conditions.

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The manufacturer's data and historical data from the reviewed occurrences indicate that, in icing conditions, the aircraft's stall speed can increase substantially from 78 to 92 knots due to residual ice on the aircraft. As well, the manufacturer's data indicate that the operation of the de-icing equipment can increase the stall speed of the aircraft by 10 knots, resulting in a possible stall speed of over 100 knots in icing conditions while the de-icing equipment is operating. The manufacturer has set a minimum operating airspeed of 105 knots in icing conditions, which provides little threshold above an impending stall. In addition, the operation of the aircraft's stall warning system in icing conditions may not be reliable due to the effects of residual ice. This further reduces the pilot's ability to safely operate the aircraft in icing conditions. Some operators indicate that they have adopted the practice of maintaining 120 knots in icing conditions. The Cessna Pilot's Operating Handbook (POH) Supplement S1, Revision 7, dated 27 June 2005, recommends exiting icing conditions when the airspeed falls below 120 knots; however, it does not specify 120 knots as the minimum airspeed in icing conditions.

On 31 January 2006, the Board released interim safety recommendations as part of its investigation (A05C0187) into this occurrence.

Board Recommendation A06-03 (31 January 2006)

Although the manufacturer has taken action to provide procedures for the operation of the Cessna 208 aircraft type in icing conditions, pilots continue to experience difficulty in maintaining control of the aircraft and exiting those conditions as specified in the aircraft flight manual (AFM). Although the aircraft is approved for flight into moderate icing conditions, continuing occurrence experience and the manufacturer's data indicate that the aircraft may not be able to safely operate in those conditions or to safely exit those conditions as specified in the AFM. Therefore, the Board recommended that:

> The Federal Aviation Administration take action to revise the certification of Cessna 208, 208A, and 208B aircraft to prohibit flight into forecast or in actual icing meteorological conditions exceeding "light," until the airworthiness of the aircraft to operate in such conditions is demonstrated.
>
> A06-03

Response to A06-03 (19 May 2006)

Although the Federal Aviation Administration (FAA) has not yet provided the TSB with a direct response regarding its actions taken in response to TSB Recommendation A06-03, the FAA letter dated 13 March 2006 in response to National Transportation Safety Board Recommendation A06-02 is pertinent to the risks identified in TSB Recommendation A06-03. To address the subject of Cessna 208 operation into icing conditions, the FAA issued Airworthiness Directive (AD) 2006-06-06 on 10 March 2006. This mandatory corrective action allows dispatch into forecast icing meteorological conditions exceeding "light," but requires pilots to exit moderate or more severe icing conditions if such conditions are encountered in flight. Cues are provided to enable pilots to determine when they must depart the icing conditions. The AD discusses the actions necessary to remove the restrictions imposed for flight in icing conditions. The FAA AD became effective 24 March 2006.

On 19 May 2006, the FAA advised the TSB that Recommendation A06-03 had been forwarded to the Wichita Aircraft Certification Office for review and evaluation. The FAA Office of Accident Investigation is waiting for a reply from the Wichita Aircraft Certification Office.

Board Assessment of the Response to A06-03 (14 June 2006)

The action taken by the FAA to date still allows the dispatch of aircraft into forecast icing conditions exceeding "light." However, AD 2006-06-06 will require that pilots exit moderate or more severe icing conditions when such conditions are encountered. The above FAA action will reduce, but not substantially reduce or eliminate, the deficiency raised in Board Recommendation A06-03.

Therefore, the response is assessed as **Satisfactory in Part**.

Next TSB Action (14 June 2006)

The Board will follow up the FAA's response to determine to what extent, if any, pilots continue to experience difficulty in operating Cessna 208 aircraft in icing conditions, in light of FAA AD 2006-06-06.

This deficiency file is assigned an **Active** status.

Response to A06-03 (18 September 2006)

On 27 September 2006, the Board received a letter dated 18 September 2006 in which the FAA responded to Recommendation A06-03. The response stated that the FAA agrees with the intent of the recommendation, and has taken action by issuing AD 2006-06-06, which limits the operation of the Cessna 208 and 208B in icing conditions. The response also indicates that the FAA assesses its response as fully meeting the intent of this TSB recommendation.

Board Reassessment of the Response to A06-03 (16 November 2006)

FAA AD 2006-06-06 will require that pilots exit moderate or more severe icing conditions, when such conditions are encountered. In addition, AD 2006-06-06 provides a definition of icing conditions of moderate or greater intensity as they apply to the Cessna 208 and 208B type, identifies several cues to enable pilots to determine when they must depart such icing conditions, and provides guidance on how to exit icing conditions exceeding "light." Notwithstanding, the results of the FAA flight tests and review of accident data have not demonstrated that a Cessna 208 or 208B can successfully exit from such icing conditions. Effectively, the action taken by the FAA still allows the dispatch of aircraft into forecast icing conditions exceeding "light." The FAA action taken will reduce, but will not substantially reduce or eliminate, the deficiency raised in Board Recommendation A06-03.

Therefore, the response is assessed as **Satisfactory in Part**.

Next TSB Action (16 November 2006)

The Board will follow up the FAA's response to determine to what extent, if any, pilots continue to experience difficulty in operating Cessna 208 aircraft in icing conditions, in light of FAA AD 2006-06-06.

This deficiency file is assigned an **Active** status.

Response to A06-03 (17 July 2007)

The FAA issued AD 2007-10-15 on 17 May 2007. This mandatory AD continues to allow dispatch into forecast icing meteorological conditions exceeding "light," but requires pilots to exit moderate or more severe icing conditions if such conditions are encountered in flight. Cues are provided to enable pilots to determine when they must depart the icing conditions. The AD supersedes AD 2006-06-06, and mandates the installation of a Low Airspeed Awareness System, and changes to procedures related to airspeeds and flap configurations for flight in icing conditions. The FAA AD became effective 21 June 2007.

The Cessna 208 POH Supplement S1, Revision 10 has been revised to accommodate the changes mandated by the FAA AD. Also included in Supplement S1, Revision 10 is a revised Performance section, containing an Enroute Tool for Exiting Icing (WAT chart) to warn pilots of performance issues affecting ability to exit icing conditions, at various temperatures and altitudes. If certain flight conditions, indicated as area "C" in the Supplement S1 WAT chart, are expected to be encountered en route, pilots are required to determine exit strategies before departure.

The FAA has participated in testing of the Cessna 208 model type in various forms of airborne icing conditions, to verify the effects of revisions to the POH and aircraft design changes.

The FAA and the manufacturer have indicated that further changes to the design of the Cessna 208 de-icing and anti-icing systems are in testing for design approval. A two-position stall warning system is being evaluated. This change would give a better warning to crews of angles of attack approaching the stall, in icing conditions. As well, a replacement of some of the existing anti-icing systems with a TKS anti-icing system is being tested for design approval. This change is designed to improve the performance of the anti-icing and de-icing systems, and the flight characteristics of the aircraft in icing conditions.

Monitoring of Cessna 208 Aircraft Occurrences

During the 12-month period from March 2006 to March 2007, three icing-related occurrences were reported to the TSB. No injuries or aircraft damage were reported. One occurrence involved a loss of control in cruise flight due to icing-related performance losses. The other two aircrew made emergency descents, one of which required an in-flight diversion, due to loss of performance in icing conditions.

Board Reassessment of the Response to A06-03 (31 May 2007)

The FAA has issued AD 2007-10-15, and has participated in aircraft testing and proposed design changes. The action taken and proposed by the FAA in conjunction with the manufacturer will, if fully implemented, substantially reduce or eliminate the safety deficiency raised in Board Recommendation A06-03.

The response is assessed as **Satisfactory Intent**.

Next TSB Action (31 May 2007)

The Board will follow up on the FAA response to determine to what extent, if any, pilots continue to experience difficulty in operating Cessna 208 aircraft in icing conditions, in light of revisions to the POH Supplement S1, the FAA AD 2007-10-15, and the other changes to the aircraft type mentioned above.

Monitoring of Cessna 208 Aircraft Occurrences 2007-2008

During the 14-month period from March 2006 to May 2008, one icing-related occurrence was reported to the TSB. No injuries or aircraft damage were reported. The occurrence involved a loss of airspeed in cruise flight, requiring an emergency descent, due to a rapid accumulation of airframe ice. The crew took action in accordance with amended procedures in the Cessna 208B POH Supplement S1, and exited icing conditions without further incident.

Action by the Manufacturer, Cessna Aircraft, 2007-2008

The manufacturer has indicated that proposed changes to the design of the Cessna 208 and 208B de-icing and anti-icing systems was tested and submitted for design approval. A TKS de-icing/anti-icing system was "technically" certified on the Cessna 208B in late March 2008; however, there is still some follow-on work before Cessna can receive full flight-into-known-icing certification for that system. This testing and certification is expected by late summer 2008. TKS was incorporated as a block change to the Cessna 208s, which includes an avionics change to the Garmin G-1000. There is no TKS approval for the Cessna 208N/L (no-letter) as of yet. A two-position stall warning has not been pursued at this time. There are plans to discuss a long-term solution to replace the current stall warning system.

Supplement S1 for AFM/POH 208BPHBUS (aircraft equipped Garmin G-1000) has been released. Various Service Bulletins and Service Newsletters were sent out since the beginning of 2007 addressing Cessna 208 flight into icing and detailing the incorporation of the changes to Cessna 208 systems, training and procedures. Manufacturer-approved training for Cessna 208 operators has been carried out before the onset of winter weather for several seasons.

Response to A06-03 (2007-2008)

The FAA has monitored the progress of design changes, required training and procedures related to the Cessna 208 aircraft type. The FAA has approved a revised Cessna 208 series Supplement S1 for ice-protected aircraft, and AFM/POH 208BPHBUS for aircraft equipped with Garmin G-1000. The supplements contain the revised procedures for required training, and pre-flight and in-flight procedures for the various systems.

Board Reassessment of the Response to A06-03 (13 August 2008)

The actions taken by the FAA and the manufacturer have substantially reduced or eliminated the safety deficiency raised in Board Recommendation A06-03.

The response is assessed as **Fully Satisfactory**.

Next TSB Action (13 August 2008)

No further action is required.

This deficiency file is assigned an **Inactive** status.