Docket No. SA-533

Exhibit No. 2-GGG

NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

FAA Icing Fact Sheet

(4 Pages)

Federal Aviation Administration

Fact Sheet

For Immediate Release

February 13, 2009
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Flying In Icing Conditions

The FAA has taken short-and long-term safety actions over the past 15 years to improve safety of aircraft that encounter icing conditions on the ground and in flight.

Background

Since 1994, the FAA has issued more than 100 airworthiness directives to address icing safety issues on more than 50 specific aircraft types. These orders cover safety issues ranging from crew operating procedures in the icing environment to direct design changes. We also have changed airplane flight manuals and other operating documents to address icing safety, and issued bulletins and alerts to operators emphasizing icing safety issues.

In addition to many short-term initiatives, the FAA has issued one final rule, has another in final executive coordination, and two proposed rules under development that address the NTSB recommendations.

FAA Actions

The following FAA actions have reduced icing-related accidents:

In **1996**, the FAA mandated (AD 96-09-25) an Airplane Flight Manual (AFM) revision to limit or prohibit the use of various flight control devices and provide flight crews with recognition queues and procedures for exiting from severe icing conditions.

In **1999**, the FAA issued an Airworthiness Directive (AD 99-19-18) that mandated revisions to AFM to advise flight crews to activate airframe pneumatic de-icing boots at the first sign of ice accumulation.

The FAA has issued ADs on aircraft such as the Mitsubishi MU-2 and the Cessna 208, given their history of icing-related accidents and incidents.

On **March 29, 2006**, the FAA issued Safety Alert for Operators (SAFO 06002) on ground deicing practices for turbine airplanes in nonscheduled Part 135 and Part 91 service.

On **October 6, 2006**, the FAA issued a Safety Alert for Operators (SAFO 06014) to warn against the hazards posed by polished frost.

On **November 11, 2006**, the FAA issued a Safety Alert for Operators (SAFO 06016) to increase awareness of in-flight icing dangers for pilots flying turbo-propeller powered airplanes.

On **April 26, 2007**, the FAA proposed a rule to require an effective way to detect ice buildup or let pilots know that icing conditions exist, and produce timely activation of the ice-protection system. It would help avoid accidents and incidents where pilots are either completely unaware of ice accumulation or think the icing is not significant enough to warrant turning on their ice-protection equipment. This rule would mandate that future airplane designs use one of three methods to detect icing and activation the ice-protection system:

An ice-detection system that automatically activates or alerts pilots to activate the ice-protection system
A definition of visual signs of ice buildup on a specified surface (e.g., windshield wiper post or wings) combined with an advisory system that alerts the pilots to activate the ice-protection system
Identification of temperature and moisture conditions conducive to airframe icing that would be used as a cue by pilots to activate the ice-protection system.

The rule would further require that after initial activation of the ice-protection system, the system must operate continuously, automatically turn on and off, or there must be an alert to tell pilots when the system is to be cycled. The comment period closed July 25, 2007. The rule is currently in the final stages of executive review.

On **August 8, 2007**, an FAA final rule introduced new airworthiness standards for the performance and handling characteristics of transport airplanes in icing conditions. The new improves the level of safety for new airplane designs when operating in icing conditions, and will harmonize the U.S. and European airworthiness standards for flight in icing conditions.

The rule adds a comprehensive set of airworthiness requirements that manufacturers must meet to receive approval for flight in icing conditions, including specific performance and handling qualities requirements, and the ice accretion (size, shape, location, and texture of ice) that must be considered for each phase of flight. These revisions will ensure that minimum operating speeds determined during the certification of all future transport airplanes will provide adequate maneuvering capability in icing conditions for all phases of flight.

On **November 30, 2007**, the FAA issued Safety Alert for Operators (SAFO 07009) to inform owners, operators, and FAA entities of training requirements for pilots of CE-208 (Cessna Caravan 1) and CE-208B (Cessna Grand Caravan) airplanes for flight into icing conditions.

In **December 2007**, the FAA issued Advisory Circular (AC 91-74A) on the affect of ice crystals on turbine engines.

On **May 8, 2008**, the FAA proposed a rule to remove language from its regulations that allowed some operators – not commercial airplanes – to operate with polished frost. Unlike commercial airplanes which must have a clean wing, corporate aircraft were permitted to fly with smooth or “polished frost.” That practice has been deemed unsafe. The comment period closed August 6, 2008.

On **May 20, 2008**, the FAA issued Safety Alert for Operators (SAFO 0812) on aircraft taxi operations during snow and ice conditions.

On **February 11, 2009**, the FAA issued Safety Alert for Operators (SAFO 09004) to emphasize preflight and in-flight planning for winter airport operations for taxi, takeoff, and landing. It also elaborates on SAFO 0812.

Rules Under Development

The FAA is also developing a proposed rule change under which air carrier airplanes are operated that would require either the installation of ice detection equipment or changes to the procedures for activating the ice-

protection system to ensure timely activation of the ice-protection system. This proposed rule would apply to all current and future airplanes in service with air carriers whose maximum takeoff weight is less than 60,000 pounds.

The FAA is also developing a proposed rule to address supercooled large drop icing, which is outside the icing envelope considered by the current icing certification requirements. The proposed rule would improve safety by taking into account supercooled large-drop icing conditions for transport category airplanes most affected by these icing conditions, mixed-phase and ice-crystal conditions for all transport category airplanes, and supercooled large drop, mixed phase, and ice-crystal icing conditions for all turbine engines. An economic analysis is currently being prepared.

FAA SAFOs are available at:

http://www.faa.gov/other_visit/aviation_industry/airline_operators/airline_safety/safo/all_safos/

Icing Terms Commonly Used in Aviation:

Clear ice: See “glaze ice.”

Freezing rain (FZRA): Precipitation at the ground level or aloft in the form of liquid water drops. The raindrop diameters are greater than 0.5 mm. Freezing rain exists at air temperatures less than 0degC (supercooled), remains in liquid form, and freezes on contact with objects on the surface or airborne.

Glaze ice: Sometimes glaze ice is clear and smooth. Glaze ice usually contains some air pockets that result in a lumpy translucent appearance. Glaze ice results from supercooled drops striking a surface but not freezing rapidly on contact. Glaze ice is denser, harder, and sometimes more transparent than rime ice. Factors, which favor glaze formation, are those that favor slow dissipation of the heat of fusion (i.e., slight supercooling and rapid accretion). With larger accretions, the ice shape typically includes “horns” protruding from unprotected leading edge surfaces. Flight crews are more likely to assess the ice shape, rather than the clarity or color of the ice, accurately from the cockpit. The terms “clear” and “glaze” have been used for essentially the same type of ice accretion. Some reserve “clear ice” for thinner accretions that lack horns and conform to the airfoil.

Heavy icing: A descriptor used operationally by flight crews when they report encountered icing intensity to air traffic control. The rate of ice buildup requires maximum use of the ice-protection systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is more than 3 inches (7.5 cm) per hour on the outer wing. A pilot encountering such conditions should consider immediate exit from the conditions.

Ice bridging: Classic pneumatic deicing boot ice bridging occurs when a thin layer of ice is sufficiently plastic to deform to the shape of the inflated deicing boot. This occurs without the thin ice breaking or shedding during ensuing cycling of the deicing boot. As the deformed ice hardens and accretes more ice, the deicing boot becomes ineffective. Ice bridging may occur when enough supercooled water freezes during the inflated deicing boot dwell period. It will keep that shape after the deicing boot deflates and will form a deformed surface that continues to accrete ice and is unaffected by ensuing cycling of the deicing boot. A deicing boot ice bridge may also form when flying into increasingly colder ambient temperature conditions following a mixed-phase icing encounter at near-freezing temperatures. Ice bridging also refers to the ice “caps” or “bridges” between adjacent component surfaces. For example, unprotected leading edge surfaces of an elevator horn and the horizontal stabilizer.

Light icing: A descriptor used operationally by flight crews when they report encountered icing intensity to traffic control. The rate of ice buildup requires occasional cycling of manual deicing systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is 1/4 inch to one inch (0.6 to 2.5 cm) per hour on the outer wing. The pilot should consider exiting the condition.

Mixed ice: A simultaneous appearance or a combination of rime and glaze ice characteristics. Accurate identification of mixed ice from the cockpit may be difficult since the clarity, color, and shape of the ice will be a mixture of rime and glaze characteristics.

Moderate icing: A descriptor used operationally by flight crews to report encountered icing intensity to traffic control. The rate of ice buildup requires frequent cycling of manual deicing systems to minimize ice accretions on the airframe. A representative accretion rate for reference purposes is 1 to 3 inches (2.5 to 7.5 cm) per hour on the outer wing. The pilot should consider exiting the condition as soon as possible.

Rime ice: A rough, milky, opaque ice formed by the rapid freezing of supercooled drops after they strike the aircraft. The rapid freezing results in trapped air. The trapped air gives the ice its opaque appearance and makes it porous and brittle. Rime ice typically accretes along the stagnation line of an airfoil and is more regular in shape and conforms more to the airfoil than glaze ice. Crew are more likely to assess the ice shape, rather than the clarity or color of the ice accurately from the cockpit.

Runback ice: Ice that forms from the freezing or refreezing of water leaving protected surfaces and running back to unprotected surfaces.

Severe icing: A descriptor used operationally by flight crews reporting encountered icing intensity to traffic control. The rate of ice buildup results in the inability of the ice protection systems to remove the buildup of ice satisfactorily. Also, ice builds up in locations not normally prone to icing, such as areas aft of protected surfaces and any other areas identified by the manufacturer. Immediate exit from the condition is necessary.

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