

Docket No. SA-531

Exhibit No. 13-I

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C.

Aircraft Performance Group Chairman

AMA 525/5 Flight in Icing Conditions - Flight Characteristics

(3 pages)



AIRWORTHINESS MANUAL ADVISORY (AMA)

Subject:

FLIGHT IN ICING CONDITIONS - FLIGHT CHARACTERISTICS

1. **PURPOSE.** This advisory information provides guidance material for acceptable means, but not the only means, of demonstrating compliance with the flight characteristics requirements of Chapter 525 for the approval of Transport Category Aeroplanes for flight in icing conditions.
2. **REFERENCE AIRWORTHINESS STANDARDS.** Chapter 525 Sections 525.143 to 525.255 inclusive, 525.1093, 525.1416, 525.1419, 525.1525, 525.1581, and Appendix C.
3. **BACKGROUND AND DISCUSSION.** The equipment design requirements for ice protection are contained in Chapter 525 Sections 525.1093, 525.1416 and 525.1419. FAA Advisory Circular 20-73 contains information relating to substantiation of ice protection systems and AMA 525/2-X provides additional advisory information for Performance aspect of flight in icing conditions; this AMA instead provides additional advisory information for the Flight Characteristics aspects of flight in icing conditions.
4. **PROCEDURES.**
 - 4.1 In general, flight in icing conditions can include take-off and climb, cruise, descent and landing. During the take-off phase it may be assumed that there is negligible ice accumulation, but operation of the ice protection systems has to be considered. For the other flight phases it should be assumed that operation of the ice protection systems is required. Approval of flight in icing conditions requires compliance with the following requirements:
 - (a) Flight characteristics with ice accumulations appropriate to 45 min in Chapter 525 Appendix C conditions (3 inch maximum) on the unprotected surfaces and normally expected ice on the protected surfaces prior to anti-icing system activation or during de-icing system operation.
 - (b) Demonstration of freedom from hazardous flight characteristics with ice accumulation resulting from probable single failure conditions or probable delays in crew operating procedures. For failure conditions which require that the aircraft leave the icing conditions as soon as possible, the ice accumulation may be assured to be one half of the accumulation specified in (a) above.
 - (c) Adequate Aircraft Flight Manual (AFM) procedures including procedures for anti-icing and de-icing system failure conditions.

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4.2 The following items have been found to be significant in past certification programs. It is recognized that for a particular aircraft the list may not be complete.

- (a) Demonstration of adequate stall warning;
- (b) Demonstration of satisfactory stall characteristics;
- (c) Demonstration of adequate stability and control in the chosen approach configuration. This includes ± 0.5 'g' Longitudinal Control capability and positive Static Lateral/Directional Stability, Static Longitudinal Stability and Dynamic Stability at V_{APP} to V_{EE} .
- (d) Demonstration of safe procedures for configuration changes for approach, landing and go-around. This includes selection of landing flap at V_{APP} to V_{EE} .
- (e) Demonstration of adequate Static Longitudinal Stability and Dynamic Stability in the cruise configuration.
- (f) Demonstration of freedom from vibration and buffet with de-icer boot operation at speeds up to V_{FC} .
- (g) Demonstration of no adverse fluctuations of altitude or airspeed (e.g. caused by ice build-up on nose radome).
- (h) Demonstration of no hazard associated with ice shedding (e.g. from propellers, under wing de-icer boots, lights).
- (i) Establishment of adequate AFM procedures for anti-icing and de-icing systems operation. (e.g. minimum "N1" for adequate bleed air supply).
- (j) Establishment of adequate AFM procedures for anti-icing or de-icing system failures or other applicable failures (e.g. engine failure). Tests should be carried out in simulated failure conditions to ensure no hazardous characteristics exist.
- (k) Establishment of any systems limitations/procedures when operating in icing conditions (e.g. autopilot must be disengaged).

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