Proposed Rules

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This section of the FEDERAL REGISTER contains notices to the public of the proposed issuance of rules and regulations. The purpose of these notices is to give interested persons an opportunity to participate in the rule making prior to the adoption of the final rules.

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Parts 25 and 33

[Docket No. FAA–2010–0636; Notice No. 10–10]

RIN 2120–AJ34

Airplane and Engine Certification Requirements in Supercooled Large Drop, Mixed Phase, and Ice Crystal Icing Conditions

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of Proposed Rulemaking (NPRM).

SUMMARY: The Federal Aviation Administration proposes to amend the airworthiness standards applicable to certain transport category airplanes certified for flight in icing conditions and the icing airworthiness standards applicable to certain aircraft engines. The proposed regulations would improve safety by addressing 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. These proposed regulations are the result of information gathered from a review of icing accidents and incidents.

DATES: Send your comments on or before August 30, 2010.

ADDRESSES: You may send comments identified by Docket Number FAA–2010–0636 using any of the following methods:

- *Federal eRulemaking Portal:* Go to *http://www.regulations.gov* and follow the online instructions for sending your comments electronically.
- *Mail:* Send comments to Docket Operations, M–30; U.S. Department of Transportation, 1200 New Jersey Avenue, SE., Room W12–140, West Building Ground Floor, Washington, DC 20590–0001.
- *Hand Delivery or Courier:* Bring comments to Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.
- *Fax:* Fax comments to Docket Operations at 202–493–2251.

For more information on the rulemaking process, *see* the **SUPPLEMENTARY INFORMATION** section of this document.

Privacy: The FAA will post all comments we receive, without change, to *http://www.regulations.gov,* including any personal information you provide. Using the search function of our docket Web site, anyone can find and read the electronic form of all comments received into any of our dockets, including the name of the individual sending the comment (or signing the comment for an association, business, labor union, etc.). You may review DOT's complete Privacy Act Statement in the **Federal Register** published on April 11, 2000 (65 FR 19477–78) or you may visit *http://DocketsInfo.dot.gov.*

Docket: To read background documents or comments received, go to *http://www.regulations.gov* at any time and follow the online instructions for accessing the docket. Or, go to Docket Operations in Room W12–140 of the West Building Ground Floor at 1200 New Jersey Avenue, SE., Washington, DC, between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays.

FOR FURTHER INFORMATION CONTACT: For part 25 technical questions contact Robert Hettman, FAA, Propulsion/Mechanical Systems Branch, ANM–112, Transport Airplane Directorate, Aircraft Certification Service, 1601 Lind Avenue, SW., Renton, WA 98057–3356; telephone (425) 227–2683; facsimile (425) 227–1320, e-mail *robert.hettman@faa.gov.*

For part 33 technical questions contact John Fisher, FAA, Rulemaking and Policy Branch, ANE–111, Engine and Propeller Directorate Standards Staff, Aircraft Certification Service, 12 New England Executive Park, Burlington, MA 01803; telephone (781) 238–7149, facsimile (781) 238–7199, e-mail *john.fisher@faa.gov.*

For part 25 legal questions contact Douglas Anderson, FAA, Office of the Regional Counsel, ANM–7, Northwest Mountain Region, 1601 Lind Avenue, SW., Renton, WA 98057–3356; telephone (425) 227–2166; facsimile (425) 227–1007, e-mail *douglas.anderson@faa.gov.*

For part 33 legal questions contact Vince Bennett, FAA, Office of the Regional Counsel, ANE–007, New England Region, 12 New England Executive Park, Burlington, MA 01803; telephone (781) 238–7044; facsimile (781) 238–7055, e-mail *vincent.bennett@faa.gov.*

SUPPLEMENTARY INFORMATION: Later in this preamble under the Additional Information section, the FAA discusses how you can comment on this proposal and how the agency will handle your comments. Included in this discussion is related information about the docket, privacy, and the handling of proprietary or confidential business information. The FAA also discusses how you can get a copy of this proposal and related rulemaking documents.

Authority for This Rulemaking

The FAA's authority to issue rules on aviation safety is found in Title 49 of the United States Code. Subtitle I, section 106 describes the authority of the FAA Administrator. Subtitle VII, Aviation Programs, describes in more detail the scope of the agency's authority.

This rulemaking is proposed under the authority described in subtitle VII, part A, subpart III, section 44701, "General requirements." Under that section, the FAA is charged with promoting safe flight of civil aircraft in air commerce by prescribing minimum standards required in the interest of safety for the design and performance of aircraft; regulations and minimum standards in the interest of safety for inspecting, servicing, and overhauling aircraft; and regulations for other practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it would prescribe—

- New safety standards for the design and performance of certain transport category airplanes and aircraft engines; and
- New safety requirements that are necessary for the design, production, and operation of those airplanes, and for other practices, methods, and

procedures relating to those airplanes and engines.

Summary of the Proposal

The FAA proposes to revise certain regulations in Title 14, Code of Federal Regulations (14 CFR) part 25 (Airworthiness Standards: Transport Category Airplanes) and part 33 (Airworthiness Standards: Aircraft Engines) related to the certification of transport category airplanes and turbine aircraft engines in icing conditions. We also propose to create new regulations: § 25.1324—Angle of attack systems; § 25.1420 SLD icing conditions; part 25, appendix O (SLD icing conditions); part 33, appendix C (this will be intentionally left blank as a placeholder); and part 33, appendix D (Mixed phase and ice crystal icing conditions). To improve the safety of transport category airplanes operating in SLD, mixed phase, and ice crystal icing conditions, the proposed regulations would:

- Expand the certification icing environment to include freezing rain and freezing drizzle.
- Require airplanes most affected by SLD icing conditions to meet certain safety standards in the expanded certification icing environment, including additional airplane performance and handling qualities requirements.
- Expand the engine and engine installation certification, and some airplane component certification regulations (for example, angle of attack and airspeed indicating systems), to include freezing rain, freezing drizzle, ice crystal, and mixed phase icing conditions. For certain cases, a subset of these icing conditions is proposed.

The benefits and costs are summarized below. The estimated benefits are $405.6 million ($99.5 million present value). The total estimated costs are $71.0 million ($54.0 million present value). On an annualized basis, for the time period 2012–2064, the benefits are $7.0 million, and the costs are $3.8 million.

	Nominal benefits	PV benefits
Benefits		
Smaller & Medium Airplanes	$249,580,915	$69,994,259
Larger Airplanes	156,004,884	29,498,469
Total Benefits	405,585,799	99,492,728
		(7.0 million annually)
Costs		
	Nominal cost	PV cost
Engine Cert Cost	7,936,000	6,931,610
Engine Capital Cost	*6,000,000*	*5,240,632*
Total Engine	13,936,000	12,172,242
Smaller Airplane Certification Cost	24,999,039	21,835,129
New Larger Airplane Certification Cost	3,154,600	2,755,350
Derivative Larger Airplane Certification Cost	10,438,800	9,117,652
Hardware Costs	10,390,000	5,842,024
Fuel Burn All	8,046,676	2,261,941
Total Costs	70,965,115	53,984,338
		($3.8 million annually)

Background

In the 1990s, the FAA became aware that the types of icing conditions considered during the certification of transport category airplanes and turbine aircraft engines needed to be expanded to increase the level of safety during flight in icing. The FAA determined that the revised icing certification standards should include supercooled large drops (SLD), mixed phase, and ice crystals.[1]

Safety concerns about the adequacy of the icing certification standards were brought to the forefront of public and governmental attention by a 1994 accident in Roselawn, Indiana, involving an Avions de Transport Regional ATR 72 series airplane. The FAA, Aerospatiale, the French Direction Général de l'Aviation Civile, Bureau Enquete Accident, the National Aeronautics and Space Administration, the National Transportation Safety Board (NTSB), and others conducted an extensive investigation of this accident. These investigations led to the conclusion that freezing drizzle conditions created a ridge of ice on the wing's upper surface aft of the deicing boots and forward of the ailerons. It was further concluded that this ridge of ice contributed to an uncommanded roll of the airplane. Based on its investigation, the NTSB recommended changes to the icing certification requirements.

The certification requirements for icing conditions are specified in part 25, appendix C. The atmospheric condition (freezing drizzle) that contributed to the Roselawn accident is currently outside the icing envelope for certifying transport category airplanes. The term "icing envelope" is used within part 25, appendix C, and this NPRM to refer to the environmental icing conditions within which the airplane must be shown to be able to safely operate. The term "transport category airplanes" is used throughout this rulemaking document to include all airplanes type certificated to part 25 regulations.

Another atmospheric icing condition that is currently outside the icing envelope is freezing rain. The FAA has not required airplane manufacturers to show that airplanes can operate safely in freezing drizzle or freezing rain conditions. These conditions constitute an icing environment known as supercooled large drops (SLDs).

As a result of this accident and consistent with related NTSB

[1] Appendix 1 of this preamble contains definitions of certain terms used in this notice of proposed rulemaking (NPRM).

recommendations [2] the FAA tasked the Aviation Rulemaking Advisory Committee (ARAC),[3] through its Ice Protection Harmonization Working Group (IPHWG), to do the following:

- Define an icing environment that includes SLDs.
- Consider the need to define a mixed phase icing environment (supercooled liquid and ice crystals).
- Devise requirements to assess the ability of an airplane to either safely operate without restrictions in SLD and mixed phase conditions or safely operate until it can exit these conditions.
- Study the effects icing requirement changes could have on §§ 25.773, Pilot compartment view; 25.1323, Airspeed indicating system; and 25.1325, Static pressure systems.
- Consider the need for a regulation on ice protection for angle of attack probes.

This proposed rule is based on the ARAC's recommendations to the FAA. Terms used in this notice of proposed rulemaking (NPRM) are defined in Appendix 1 of this preamble.

A. Existing Regulations for Flight in Icing Conditions

Currently, the certification regulations applicable to transport category airplanes for flight in icing conditions require that: "The airplane must be able to operate safely in the continuous maximum and intermittent maximum icing conditions of appendix C." [4] The certification regulations also require minimum performance and handling qualities in these icing conditions and methods to detect airframe icing and to activate and operate ice protection systems.[5] Icing regulations applicable to engines are in §§ 33.68 and 33.77. Operating regulations in parts 91 (General Operating and Flight Rules) and 135 (Operating Requirements: Commuter and On Demand Operations) address limitations in icing conditions for airplanes operated under these parts.[6] Part 121 (Operating Requirements: Domestic, Flag and Supplemental Operations) addresses operations in icing conditions that might adversely affect safety and requires installing certain types of ice protection equipment and wing illumination equipment.[7]

Some of the part 25 and 33 regulations specify that the affected equipment must be able to operate in some or all of the icing conditions defined in part 25, appendix C. Other regulations within these parts do not specify the icing conditions that must be considered for airplane certification, but, historically, airplane certification programs have only considered icing conditions that are defined in appendix C.

Appendix C addresses continuous maximum and intermittent maximum icing conditions within stratiform and cumuliform clouds ranging from sea level up to 30,000 feet. Appendix C defines icing cloud characteristics in terms of mean effective drop diameters, liquid water content, temperature, horizontal and vertical extent, and altitude. Icing conditions that contain drops with mean effective diameters that are larger than the cloud mean effective drop diameters defined in appendix C are typically referred to as freezing drizzle or freezing rain. Icing conditions containing freezing drizzle and freezing rain are not currently considered when certifying an airplane's ice protection systems. Because the larger diameter drops typically impinge farther aft on the airfoil, exposure to these conditions can result in ice accretions aft of the ice protection area, which can negatively affect airplane performance and handling qualities.

Likewise, mixed phase (supercooled liquid and ice crystals) and 100% ice crystal icing conditions are not currently considered when certifying an airplane's ice protection systems. Exposing engines and externally mounted probes to these conditions could result in hazardous ice accumulations within the engine that may result in engine damage, power loss, and loss of or misleading airspeed indications. The certification regulations for transport category airplanes and engines do not address the safe operation of airplanes in SLD, mixed phase, or ice crystal icing conditions and the operating rules do not specifically prohibit operations in these conditions.

B. National Transportation Safety Board Safety Recommendations

The NTSB issued NTSB Safety Recommendation Numbers A–96–54 [8] and A–96–56 [9] as a result of the Roselawn accident previously discussed. This rulemaking activity partially addresses the NTSB recommendations because there are separate rulemaking activities associated with revisions to 14 CFR part 23 regulations for small airplanes and 14 CFR part 121 operational regulations. The NTSB recommendations are as follows:

1. A–96–54

Revise the icing criteria published in 14 Code of Federal Regulations (CFR), parts 23 and 25, in light of both recent research into aircraft ice accretion under varying conditions of liquid water content, drop size distribution, and temperature, and recent developments in both the design and use of aircraft. Also, expand the appendix C icing certification envelope to include freezing drizzle/freezing rain and mixed water/ice crystal conditions, as necessary. (Class II, Priority Action) (A–96–54) (Supersedes A–81–116 and—118)

2. A–96–56

Revise the icing certification testing regulation to ensure that airplanes are properly tested for all conditions in which they are authorized to operate, or are otherwise shown to be capable of safe flight into such conditions. If safe operations can not be demonstrated by the manufacturer, operational limitations should be imposed to prohibit flight in such conditions and flightcrews should be provided with the means to positively determine when they are in icing conditions that exceed the limits for aircraft certification. (Class II, Priority Action) (A–96–56)

C. Related Rulemaking Activity

The ARAC's Ice Protection Harmonization Working Group (IPHWG) submitted additional part 121 icing rulemaking recommendations to the FAA that may lead to future rulemaking, but do not directly impact this NPRM. Those recommendations would improve airplane safety when operating in icing conditions. The recommendations would:

- Address when ice protection systems must be activated.

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[2] NTSB recommendations A–96–54 and A–96–56; available in the Docket and on the Internet at: *http://www.ntsb.gov/Recs/letters/1996/A96_48_69.pdf.*

[3] Published in the **Federal Register**, December 8, 1997 (62 FR 64621).

[4] 14 CFR 25.1419, Ice Protection.

[5] For a complete discussion of the regulations see Amendment 25–121 (72 FR 44665, August 8, 2007), and Amendment 25–129 (74 FR 38328, August 3, 2009).

[6] 14 CFR 91.527, Operating in icing conditions; and § 135.227, Icing conditions: Operating limitations.

[7] 14 CFR 121.629(a), Operation in icing conditions and § 121.341, Equipment for operations in icing conditions.

[8] NTSB recommendation A–96–54; available in the Docket and on the Internet at: *http://www.ntsb.gov/Recs/letters/1996/A96_48_69.pdf.*

[9] NTSB recommendation A–96–56; available in the Docket and on the Internet at: *http://www.ntsb.gov/Recs/letters/1996/A96_48_69.pdf.*

• Require some airplanes to exit all icing conditions after encountering large drop icing conditions conducive to ice accretions aft of the airframe's protected area.

D. Advisory Material

The proposed new AC and revisions to existing ACs would provide guidance material for one acceptable means, but not the only means, of demonstrating compliance with the proposed regulations contained in this NPRM. The guidance provided in these documents is directed at airplane manufacturers, modifiers, foreign regulatory authorities, and FAA transport airplane type certification engineers, flight test pilots, and their designees. The proposed ACs will be posted on the "Aircraft Certification Draft Documents Open for Comment" Web site, *http://www.faa.gov/aircraft/draft_docs,* after this NPRM is published in the **Federal Register**

For advisory material related to this NPRM, the FAA is:

• Developing a new AC 25–xx, Compliance of Transport Category Airplanes with Certification Requirements for Flight in Icing Conditions.

• Revising AC 20–147, Turbojet, Turboprop, and Turbofan Engine Induction System Icing and Ice Ingestion.

• Revising AC 25–25, Performance and Handling Characteristics in the Icing Conditions Specified in Part 25, Appendix C.

• Revising AC 25.629–1A, Aeroelastic Stability Substantiation of Transport Category Airplanes.

• Revising AC 25.1329–1B, Approval of Flight Guidance Systems.

General Discussion of the Proposal

The FAA proposes to revise certain regulations in parts 25 and 33 related to the certification of transport category airplanes and turbine aircraft engines in icing conditions.

We also propose to create a new: § 25.1324—Angle of attack systems; § 25.1420—Supercooled large drop icing conditions; part 25, appendix O (supercooled large drop icing conditions; part 33, appendix C (intentionally left blank); and part 33, appendix D (Mixed phase and ice crystal icing conditions). Part 33, appendix C, is intentionally left blank and retained as a placeholder for non-icing related regulations so that part 33, appendix C, would not be confused with the icing conditions defined in part 25, appendix C.

To improve the safety of transport category airplanes operating in SLD, mixed phase, and ice crystal icing conditions, the proposed regulations would:

• Expand the certification icing environment to include freezing rain and freezing drizzle.

• Require airplanes most affected by SLD icing conditions (transport category airplanes with a maximum takeoff weight less than 60,000 pounds or with reversible flight controls) to meet certain safety standards in the expanded certification icing environment, including additional airplane performance and handling qualities requirements.

• Expand the engine and engine installation certification, and some airplane component certification regulations (for example, angle of attack and airspeed indicating systems) to include freezing rain, freezing drizzle, ice crystal, and mixed phase icing conditions. For certain cases, a subset of these icing conditions is proposed.

A. Safety Concern

The ARAC's IPHWG reviewed icing events involving transport category airplanes and found accidents and incidents that are believed to have occurred in icing conditions that are not addressed by the current regulations. The icing conditions resulted in flightcrews losing control of their aircraft and, in some cases, engine power loss. The review found hull losses and fatalities associated with SLD conditions, but not for ice crystal and mixed phase conditions. However, there have been 14 documented cases of ice crystal and mixed phase engine power loss events between 1988 through 2009. Of those events, there were 13 occurrences of multi-engine power loss events. Fifty percent of those events were defined as "aircraft level events," since they occurred on multiple engines installed on the same airplane. Two of these aircraft level events resulted in diversions.

The incident history also indicates that flightcrews have experienced temporary loss of or misleading airspeed indications in icing. Airspeed indications on transport category airplanes are derived from the difference between two air pressures—the total pressure, as measured by a pitot tube mounted somewhere on the fuselage, and the ambient or static pressure, as measured by a static port. The static port may be flush mounted on the airplane fuselage or co-located on the pitot tube. When the static and pitot systems are co-located, the configuration is referred to as a pitot-static tube. Static ports are not prone to collecting ice crystals, either because of their flush mounted locations or their overall shape.

Due to the way pitot or pitot-static tubes are usually mounted, they are prone to collecting ice crystals. Encountering high concentrations of ice crystals may lead to blocked pitot or pitot-static tubes because the energy necessary to melt the ice crystals can exceed the tubes' design requirements. Pitot or pitot-static tube blockage can lead to errors in measuring airspeed. The regulatory changes which add ice crystal conditions for airspeed indicating systems are intended to apply to either a pitot tube or pitot-static tube configuration.

The IPHWG did not identify any events due to ice accumulations on probes that are used to measure angle of attack, or other angle of attack sensors. However, the IPHWG determined there are angle of attack probe designs that are susceptible to mixed phase conditions.

The IPHWG concluded that the current regulations do not adequately address SLD, mixed phase, and ice crystal conditions. The concerns regarding mixed phase and ice crystal conditions were limited to engines, propulsion installations, airspeed indications, and angle of attack systems. The FAA concurs with the IPHWG's conclusions.

B. Prior FAA Actions To Address the Safety Concern

The FAA has issued airworthiness directives (ADs) to address the unsafe conditions associated with operating certain airplanes in severe icing conditions, which can include SLD icing conditions. These ADs are applicable to airplanes equipped with both reversible flight controls in the roll axis and pneumatic deicing boots. The ADs require the flightcrews to exit icing when visual cues are observed that indicate the conditions exceed the capabilities of the ice protection equipment. In addition, for new certifications of airplanes equipped with unpowered roll axis controls and pneumatic deicing boots, the airplanes are evaluated to ensure the roll control forces are acceptable if the airplane operates in certain SLD conditions. However, the scope of these actions is limited because they do not address all transport category airplanes and do not address the underlying safety concern of the unknown performance and handling qualities safety margins for airplanes and engines operating in freezing drizzle, freezing rain, mixed phase, and ice crystal conditions. The IPHWG concluded there is a need to improve the regulations to ensure safe operation of airplanes and engines in these conditions.

C. Alternatives to Rulemaking

Before proposing new rulemaking, the FAA considers alternative ways to solve the safety issue under consideration. Following is a brief discussion of two of the alternatives we considered during deliberations on this proposed rule.

1. Alternative 1: Terminal Area Radar and Sensors

The IPHWG considered the use of terminal area radar and ground-based sensors to identify areas of SLDs so they can be avoided, rather than require certification for operations in SLD. Equipment for detecting and characterizing icing conditions in holding areas is being developed. However, the equipment would have limited coverage area. For areas not covered by terminal area radar and ground-based sensors, airborne radars and sensors are being developed that would identify SLD conditions in sufficient time for avoidance. These ground-based and airborne systems are not mature enough to provide sufficient protection for all flight operations affected by SLD. Even if the equipment was mature, rulemaking would still be necessary to establish safety margins for inadvertent flight into such conditions and to provide an option for applicants to substantiate that the airplane is capable of safe operation in SLD conditions.

2. Alternative 2: Icing Diagnostic and Predictive Weather Tools

The IPHWG considered the use of icing diagnostic and predictive weather tools to avoid SLD rather than certify an airplane to operate in SLD conditions. Tools have been developed that can provide information on icing and SLD potential, but may not report all occurrences of SLD. These experimental tools are available on the Internet and can be used to provide flight planning information guidance for avoidance of SLD conditions. However, rulemaking would still be necessary to establish safety margins for inadvertent flight into such conditions and to provide an option for applicants to substantiate that the airplane is capable of safe operation in SLD conditions.

Discussion of the Proposed Regulatory Requirements

Appendix O to Part 25

The proposed appendix O is structured like part 25, appendix C, one part defining icing conditions and one defining ice accretions. Appendix O, part I, would define SLD icing conditions and part II would define the ice accretions that a manufacturer must consider when designing an airplane.

Supercooled Large Drop Icing Conditions

Proposed § 25.1420 would add safety requirements that must be met in SLD icing conditions for certain transport category airplanes to be certified for flight in icing conditions. This change would require evaluating the operation of these airplanes in the SLD icing environment; developing a means to differentiate between different SLD icing conditions, if necessary; and developing procedures to exit all icing conditions.

The proposed regulation would require consideration of the SLD icing conditions (freezing drizzle and freezing rain) defined in a proposed new part 25, appendix O, part I, in addition to the existing part 25, appendix C, icing conditions. Proposed appendix O would include drop sizes larger than those considered by current icing regulations. These larger drops impinge and freeze farther aft on airplane surfaces than the drops defined in appendix C and may affect the airplane's performance, handling qualities, flutter characteristics, and engine and systems operations. The appendix O icing conditions, if adopted, may affect the design of airplane ice protection systems.

The SLD icing conditions described in the proposed appendix O would be those in which the airplane must be able to either safely exit following the detection of any or specifically identified appendix O icing conditions, or safely operate without restrictions. Specifically, the proposed § 25.1420 would allow three options:

- Detect appendix O conditions and then operate safely while exiting all icing conditions (§ 25.1420(a)(1)).
- Safely operate in a selected portion of appendix O conditions, detect when the airplane is operating in conditions that exceed the selected portion, and then operate safely while exiting all icing conditions (§ 25.1420(a)(2)).
- Operate safely in all of the appendix O conditions (§ 25.1420(a)(3)).

As discussed below in the section titled "Differences from the ARAC Recommendations," the proposed § 25.1420 would apply to airplanes with either: (1) a takeoff maximum gross weight of less than 60,000 pounds, or (2) reversible flight controls.

To establish that an airplane could operate safely in the proposed appendix O conditions described above, proposed § 25.1420(b) would require both analysis and one test, or more as found necessary, to establish that the ice protection for the various components of the airplane is adequate. The words "as found necessary" would be applied in the same way as they are applied in § 25.1419(b). During the certification process, the applicant would demonstrate compliance with the rule using a combination of analyses and test(s). The applicant's means of compliance would consist of analyses and the amount and types of testing it finds necessary to demonstrate compliance with the regulation. The applicant would choose to use one or more of the tests identified in paragraphs § 25.1420(b)(1) through (b)(5). Although the applicant may choose the means of compliance, it is ultimately the FAA that determines whether the applicant has performed sufficient test(s) and analyses to substantiate compliance with the regulation. Similarly, the words "as necessary," which appear in § 25.1420(b)(3) and (b)(5), would result in the applicant choosing the means of compliance that is needed to support the analysis, but the FAA would make a finding whether the means of compliance is acceptable. If an applicant has adequate data a similarity analysis may be used in lieu of the testing required by § 25.1420(b). For an airplane certified to operate in at least a portion of proposed appendix O icing conditions, proposed § 25.1420(c) would extend the requirements of § 25.1419(e), (f), (g), and (h) [10] to include activation and operation of airframe ice protection systems in the appendix O icing conditions for which the airplane is certified. Proposed § 25.1420(c) would not apply to airplanes certified to proposed § 25.1420(a)(1) because proposed § 25.1420(a)(1) would require a method to identify and safely exit all appendix O conditions.

The proposed appendix O defines SLD conditions. It was developed by the ARAC IPHWG, which included meteorologists and icing research specialists from industry, FAA/FAA Tech Center, Meteorological Services of Canada, National Aeronautics and Space Administration (NASA), and Transport Canada/Transport Development Center. The IPHWG collected and analyzed airborne measurements of pertinent SLD variables, developed an engineering standard to be used in aircraft certification, and recommended that

[10] These requirements were recently adopted in Amendment 25–129 (74 FR 38328, August 3, 2009). Generally, that amendment requires methods to detect airframe icing and to activate and operate ice protection systems.

standard to the FAA. The FAA concurs with the recommendation.

The SLD conditions defined in appendix O, part I, include freezing drizzle and freezing rain conditions. The freezing drizzle and freezing rain environments are further divided into conditions in which the drop median volume diameters are either less than or greater than the 40 microns. Appendix O consists of measured data that was divided into drop distributions within these four icing conditions. These distributions were averaged to produce the representative distributions for each condition.

The distributions of drop sizes are defined as part of appendix O. The need to include the distributions comes from the larger amount of mass in the larger drop diameters of appendix O. The water mass of the larger drops affects the amount of water that impinges on airplane components, the drop impingement, icing limits, and the ice buildup shape.

Appendix O provides a liquid water content scale factor that would be used to adjust the liquid water content for freezing drizzle and freezing rain. The scale factor is based on the liquid water contents of continuous freezing drizzle and freezing rain conditions decreasing with increasing horizontal extents.

Performance and Handling Qualities

The ice accretion definitions in proposed appendix O, part II, and the proposed revisions to the performance and handling qualities requirements for flight in icing conditions are similar to those required for flight in appendix C icing conditions. The proposals address the three options allowed by proposed § 25.1420(a). Proposed appendix O, part II, would contain definitions of the ice accretions appropriate to each phase of flight. The proposed appendix O, part II(b), would define the ice accretions used to show compliance with the performance and handling qualities requirements for any portion of appendix O in which the airplane is not certified to operate. The proposed appendix O, part II(c), would define the ice accretions for any portion of appendix O in which the airplane is certified to operate.

Proposed appendix O, part II(d), would define the ice accretion in appendix O conditions before the airframe ice protection system is activated and is performing its intended function to reduce or eliminate ice accretions on protected surfaces. This ice accretion would be used in showing compliance with the controllability and stall warning margin requirements of §§ 25.143(j) and 25.207(h), respectively, that apply before the airframe ice protection system has been activated and is performing its intended function. Even if the airplane is certified to operate only in a portion of the appendix O icing conditions, the ice accretion used to show compliance with §§ 25.143(j) and 25.207(h) must consider all appendix O icing conditions since the initial entry into icing conditions may be into appendix O icing conditions in which the airplane is not certified to operate.

To reduce the number of ice accretions needed to show compliance with § 25.21(g), the proposed appendix O, part II(e), would allow the option of using an ice accretion defined for one flight phase for any other flight phase if it is shown to be more critical than the ice accretion defined for that other flight phase.

Existing § 25.21(g)(1) [11] requires that the performance and handling qualities requirements of part 25, subpart B, with certain exceptions,[12] be met in appendix C icing conditions.[13] Proposed § 25.21(g)(3) would identify the performance and handling qualities requirements that must be met to ensure that an airplane certified to either the proposed § 25.1420(a)(1) or (a)(2) could safely exit icing if the icing conditions of proposed appendix O, for which certification is not sought, are encountered. Such an airplane would not be approved to take off in proposed appendix O icing conditions and would only need to be able to detect and safely exit those icing conditions encountered en route. Therefore, it is proposed that, in addition to the exceptions identified in the existing § 25.21(g)(1), such an airplane would not need to meet certain requirements [14] for appendix O icing conditions.

With one exception, for an airplane certified under proposed § 25.1420(a)(1) or (a)(2), the same handling qualities requirements that must currently be met for flight in appendix C icing conditions are proposed for flight in appendix O icing conditions for which certification is not sought. That exception is § 25.143(c)(1), which addresses controllability following engine failure during takeoff at V_2. Compliance with that rule would not be necessary since the airplane would not be approved for takeoff in appendix O icing conditions. No justification for a relaxation of other handling qualities requirements could be identified.

The requirements for safe operation in all or any portion of proposed appendix O icing conditions under proposed § 25.21(g)(4) are similar to those currently required for appendix C icing conditions. With one exception, the list of part 25, subpart B requirements that currently do not have to be met for flight in appendix C icing conditions would not have to be met in proposed appendix O icing conditions. The exception is that compliance with § 25.121(a), *Climb: One-engine-inoperative* would be required for appendix O icing conditions because, unlike for appendix C icing conditions, the FAA cannot justify an assumption that the ice accretion in this flight phase can be assumed insignificant. In practice, it is expected that some applicants may use an operating limitation to prohibit takeoff in appendix O icing conditions. Otherwise, the same rationales behind the requirements are used for both appendix C and appendix O icing conditions. For continued operation in appendix O icing conditions, there should effectively be no degradation in handling qualities, and any degradation in performance should be no greater than that allowed by the regulations for appendix C icing conditions.

Component Requirements for All Part 25 Transport Category Airplanes

In certification programs, both the airplane as a whole and its individual components are evaluated for flight in icing conditions. There are several rules in part 25 [15] that contain icing related requirements for specific components. We propose to revise those rules to ensure the airplane can safely operate in the new icing conditions established in this proposed rule.

Section 25.1419 requires that an airplane be able to safely operate in all of the conditions specified in appendix C, whereas the proposed § 25.1420 would not require an airplane to safely operate in all of the appendix O icing conditions. Proposed § 25.1420(a)(1) and (a)(2) only require an airplane to be capable of safely exiting icing conditions after encountering an appendix O icing condition for which that airplane will not be certified. The existing regulations for pilot compartment view, airspeed indication

[11] 14 CFR 25.21(g)(1) is proposed to be redesignated as § 25.21(g)(2).

[12] The exceptions listed in this requirement are §§ 25.121(a), 25.123(c), 25.143(b)(1) and (b)(2), 25.149, 25.201(c)(2), 25.207(c) and (d), 25.239, and 25.251(b) through (e).

[13] For a complete discussion of these requirements, *see* Amendment 25–121 (72 FR 44665, August 8, 2007).

[14] 14 CFR 25.105, 25.107, 25.109, 25.111, 25.113, 25.121, and 25.123.

[15] 14 CFR 25.773, 25.929, 25.1093, 25.1323, and 25.1325.

system, and static pressure system[16] contain requirements for operation in icing conditions. These sections would be revised to add requirements for operation in appendix O icing conditions. Section 25.1323, *Airspeed indicating system,* would also be revised to include and define mixed phase and ice crystal conditions. New proposed § 25.1324 includes an icing requirement for angle of attack systems. This would be similar to the icing requirements for airspeed indication systems. The proposed section would require the angle of attack system to be heated to prevent malfunction in appendices C and O icing conditions and in the mixed phase and ice crystal conditions defined in § 25.1323.

In the proposed revisions to the requirements for pilot compartment view, airspeed indication system, and static pressure system,[17] and the new proposed requirements for angle of attack systems, an airplane certified in accordance with § 25.1420(a)(1) or (a)(2) would not be required to be evaluated for all of appendix O. For airplanes certified in accordance with § 25.1420(a)(1), the icing conditions that the airplane is certified to safely exit following detection must be considered. For airplanes certified in accordance with § 25.1420(a)(2), the icing conditions that the airplane is certified to safely operate in, and to safely exit following detection, must be considered. For airplanes certified in accordance with § 25.1420(a)(3) and for airplanes not subject to § 25.1420, all icing conditions must be considered. Airplanes not certified for flight in icing need not consider appendix O.

The engine induction system icing section (§ 25.1093) and propeller deicing section (§ 25.929) contain requirements for operation in icing conditions. As a conservative approach to ensure safe operation of an airplane in an inadvertent encounter with icing, the existing language in § 25.1093 contains requirements for operation in icing conditions, even for an airplane that is not approved for flight in icing. Since proposed appendix O defines icing conditions that also may be inadvertently encountered, § 25.1093 would be revised to reference appendix O in its entirety. This would maintain the FAA's conservative approach for this section. Section 25.929 (propeller deicing) would also be revised to reference appendix O in its entirety.

Sections 25.929 and 25.1323 generically reference icing instead of specifically mentioning appendix C. Historically, the icing conditions specified in appendix C have been applied to these rules. For clarity, we are revising §§ 25.929 and 25.1323 so they specifically reference appendix C, as well as appendix O. The proposed revisions to icing regulations for pilot compartment view, propellers, engine induction system icing protection, airspeed indication system, static pressure system, and angle of attack system would be applicable to all transport category airplanes to ensure safe operation during operations in icing conditions.

The proposed revisions to § 25.903 would retain the existing regulations and add new subparagraphs to be consistent with the proposed part 33 changes in § 33.68. These revisions would allow for approving new aircraft type certification programs with engines certified to earlier amendment levels. The proposed revisions would make it clear that the proposed part 33 changes would not be retroactively imposed on an already type certified engine design, unless service history indicated that an unsafe condition was present.

The proposed revision to § 25.929 clarifies the meaning of the words "for airplanes intended for use where icing may be expected." The intent has been for the rule to be applicable to airplanes certified for flight in icing.

Engine and Engine Installation Requirements

The proposed revisions to §§ 25.1093, 33.68, and 33.77 would change the icing environmental requirements used to evaluate engine protection and operation in icing conditions. The reason for these changes is that the incident history of some airplanes has shown that the current icing environmental requirements are inadequate. The effect of the change would be to require an evaluation of safe operation in the revised icing environment. The proposed revision to § 25.1093 restructures paragraph (b) and adds a new Table 1—Icing Conditions for Ground Tests. The proposed rules would require engines and engine installations to operate safely throughout the SLD conditions defined in proposed new part 25, appendix O, and the newly defined mixed phase and ice crystal conditions defined in proposed new part 33, appendix D.[18] The proposed appendix D was developed by the ARAC Engine Harmonization Working Group and the Power Plant Installation Harmonization Working Group, which included meteorologists and icing research specialists from industry, FAA/FAA Tech Center, Meteorological Services of Canada, National Aeronautics and Space Administration (NASA), and Transport Canada/Transport Development Center. The ARAC recommended appendix D and the FAA concurs with the recommendation.

The proposed revision to § 25.1521 would retain the existing regulations and add a new subparagraph that would require an additional operating limitation for turbine engine installations during ground operation in icing conditions defined in § 25.1093(b)(2). That operating limitation would address the maximum time interval between any engine run-ups from idle and the minimum ambient temperature associated with that run-up interval. This limitation is necessary because we do not currently have any specific requirements for run-up procedures for engine ground operation in icing conditions. The engine run-up procedure, including the maximum time interval between run-ups from idle, run-up power setting, duration at power, and the minimum ambient temperature demonstrated for that run-up interval proposed in § 25.1521, would be included in the Airplane Flight Manual in accordance with existing § 25.1581(a)(1) and § 25.1583(b)(1).

The engine run-up procedure from ground idle to a moderate power or thrust setting is necessary to shed ice build-up on the fan blades before the quantity of ice reaches a level that could adversely affect engine operation if ice is shed into the engine. The proposed revision to § 25.1521 would not require additional testing. The ice shedding demonstration may be included as part of the § 33.68 engine icing testing.

Operating Limitations

The proposed revision to § 25.1533 would establish an operating limitation applicable to airplanes that are not certified in accordance with proposed § 25.1420(a)(1) or (a)(2). The flightcrews of these airplanes would be required to exit all icing conditions if they encounter appendix O icing conditions that the airplane has not been certified to operate in.

Expansion of Proposed Icing Requirements

The proposed regulations[19] for the airspeed indicating system and angle of

[16] 14 CFR 25.773, 25.1323, and 25.1325.

[17] *Ibid.*

[18] *See* FAA report DOT/FAA/AR–09/13, Technical Compendium from Meetings of the Engine Harmonization Working Group, March 2009 for details on appendix D and its development.

[19] 14 CFR 25.1323, and 25.1324.

attack system would address the operation of those systems in specific mixed phase and ice crystal conditions, as defined in proposed Appendix O. During the drafting of this NPRM the FAA became aware of airspeed indicating system malfunctions in environmental conditions that may not be addressed by these proposed regulations. The FAA is reviewing the malfunctions and is considering the need to change the proposed mixed phase and ice crystal parameters to include freezing rain. The maximum mixed phase and ice crystal parameters that we are considering are those defined in the proposed part 33, appendix D. The freezing rain parameters that we are considering are based on standards some manufacturers have used for airdata probes. The maximum freezing rain parameters that we are considering are:

Static air temperature	Altitude range		Liquid water content	Horizontal extent		Droplet MVD
(°C)	(ft)	(m)	(g/m3)	(km)	(nmiles)	(µm)
−2 to 0	0 to 10 000	0 to 3000	1 6 15	100 5 1	50 3 0.5	1000 2000 2000

We consider the mixed phase and ice crystal parameters defined in the proposed part 33, appendix D, plus the freezing rain parameters defined above to be adequate to prevent potential airspeed indicating system malfunctions in these newly defined environmental conditions. We request technical and economic comments on whether the proposed airspeed indicating system and angle of attack system regulations should include these expanded parameters. Based on comments we receive, we may add these parameters to the final rule.

Differences From the ARAC Recommendations

The IPHWG recommended changes to parts 25 and 33 to ensure the safe operation of airplanes and engines in icing conditions. The FAA concurs with the recommendations, but has determined it is necessary to revise to which airplanes the new airplane icing certification requirements in the proposed § 25.1420 would apply. The proposed § 25.1420 in this NPRM would apply to airplanes with either: (1) a takeoff maximum gross weight of less than 60,000 lbs (27,000 kg), or (2) reversible flight controls. An airplane with reversible flight controls in any axis (pitch, roll, or yaw), even if these flight controls are aerodynamically boosted and/or power-assisted, would be considered to have reversible flight controls under this proposed rule. An airplane with flight controls that are irreversible under normal operating conditions, but are reversible following a failure, would not be considered to have reversible flight controls under this proposed rule. Reversible, aerodynamically boosted, and power-assisted flight controls are defined in Appendix 1 to the preamble of this NPRM. The ADs described above in section B. "Prior FAA Actions to address the Safety Concern" are only applicable to airplanes equipped with both reversible flight controls in the roll axis and pneumatic deicing boots.

A group of IPHWG members (Boeing, Airbus, and Embraer, supported by Cessna) held a minority position in their belief that the applicability of the proposed § 25.1420 should exclude airplanes with certain design features. Their rationale for the position is that large transport airplanes still in production have not experienced any accidents or serious incidents as a result of flying in SLD icing conditions. These manufacturers proposed that airplanes having all three of the following design features should be excluded from compliance with § 25.1420:

(1) Gross weight in excess of 60,000 lbs (27,000 kg);

(2) Irreversible powered flight controls; and

(3) Wing leading-edge high-lift devices.

These manufacturers included the gross weight criterion in this list, in part, because size has a direct bearing on an airplane's susceptibility to the adverse effects of ice accretion. The size of an airplane determines the sensitivity of its flight characteristics to ice thickness and roughness. The relative effect of a given ice height (or ice roughness height) decreases as airplane size increases.

The irreversible powered flight controls design feature was chosen, in part, because using irreversible powered flight controls reduces an airplane's susceptibility to SLD conditions. The concern that SLD accretions can produce hinge moment or other anomalous control force/trim effects is not applicable to those systems.

The wing leading-edge high-lift devices design feature was chosen, in part, because, for wings without ice contamination, those devices provide a considerable increase in the maximum lift coefficient (CLmax) compared to fixed leading edges. When wings equipped with those devices are contaminated with ice, they have smaller relative CLmax losses due to ice accretion than wings with fixed leading edges.

The IPHWG majority (Air Line Pilots Association, International (ALPA), Civil Aviation Authority for the United Kingdom (CAA/UK), FAA/FAA Tech Center, Meteorological Services of Canada, National Aeronautics and Space Administration (NASA), SAAB, Transport Canada/Transport Development Center) did not accept the exclusion of airplanes with the three aforementioned design features because one cannot predict with confidence that the past service experience of airplanes with these specific design features will be applicable to future designs. The IPHWG majority recommended applying the new SLD airplane certification requirements proposed in the new § 25.1420 to all future transport category airplane type designs.

The IPHWG majority opposed limiting the applicability of the rule based on airplane gross weight, in part, because the ratio of wing and control surface sizes to airplane weight varies between airplane designs. Therefore, airplane takeoff weight is not a consistent indicator of lifting and control surface size or chord, which are the important parameters affecting sensitivity to a given ice accretion.

Excluding airplanes with irreversible flight controls was opposed, in part, because hinge moment and other anomalous control forces are not the only concern in SLD icing conditions. An irreversible control surface may not be deflected by the SLD accumulation but the aerodynamic efficiency of the control is likely to be degraded by the presence of SLD icing in front of the control surface.

Excluding airplanes with wing leading edge high-lift devices was opposed, in part, because there are many different designs for such devices, which may not all be equally effective in mitigating the negative effects of SLD ice accretions. The designs for those devices include:

• Slats that may be slotted or sealed to the basic wing leading edge, over or under deflected, with deflection and slotting that may be automated as a function of stall warning or airplane angle of attack;

• Krueger flaps that may be slotted or sealed to the wing leading edge, flexed to optimum curvature or conformed to the wing's leading edge lower surface; and

• Vortilons or some other vortex creating devices.

In addition, for transport category airplanes with leading edge high-lift devices, the spanwise extent of ice protection varies from 100 percent for some early turbo-jet airplane slats, to the span of two slats for later airplane designs, to none for Krueger flaps. The variations in the designs lead to varying degrees of aerodynamic benefit. Without defining the specific performance benefits associated with the above designs, the potential safety margins for SLD conditions cannot be determined.

The complete minority and majority positions are discussed in the working group report, which is available in the public docket.[20]

In order to propose a rule with the estimated costs commensurate with the estimated benefits, the FAA determined the applicability of the proposed rule should be limited based on service histories of certified airplanes, and the assumption that similar future designs will continue to not experience the safety problems addressed by this proposal. Therefore, the FAA decided to revise the IPHWG rulemaking recommendation by incorporating, in part, the IPHWG minority position to exclude airplanes with certain design features.

The FAA continues to agree with the IPHWG majority position that the presence (or conversely, the absence) of leading edge high lift devices should not be used as a basis for determining the applicability of the proposed § 25.1420. There is insufficient data to conclude either that every type of leading edge high lift device, or that a specific leading edge high lift device design will affect (positively or negatively) an airplane's ability to operate in SLD atmospheric icing conditions. Also, leading edge high lift devices are only deployed in certain phases of flight (for example, takeoff and landing), and their deployment may differ for different flap configurations. For example, a leading edge slat may be sealed in one flap configuration, but slotted (that is, with a gap opened up between the trailing edge of the slat and the wing) in others. Therefore, the applicability of the proposed § 25.1420 is not affected by the presence or absence of leading edge high lift devices.

We request comment on whether this proposed rule, if adopted, should be applied to airplanes larger than 60,000 pounds MTOW or airplanes with other design features whose presence or absence would result in the airplane being susceptible to safety problems while operating in the SLD icing conditions defined in the proposed appendix O, as well as the economic analysis associated with these decisions.[21]

This NPRM also differs from the ARAC recommendation by proposing a revision to § 25.1533 for airplanes not certified to operate in all of the SLD atmospheric icing conditions specified in the proposed new appendix O (that is, airplanes certified in accordance with proposed § 25.1420(a)(1) or (a)(2)). The proposal would establish an operating limitation that requires the flightcrews to exit all icing conditions if they encounter appendix O icing conditions in which the airplane has not been certified to operate.

Another difference between this NPRM and the ARAC recommendation concerns an ARAC recommendation to establish separate stall warning margin and controllability requirements using the ice accretion associated with detection of appendix O icing conditions that require exiting all icing conditions. For airplanes that require exiting all icing conditions after encountering certain appendix O icing conditions, the ARAC recommended (and the FAA proposes in this NPRM) stall warning margin and controllability requirements that must be met with the ice accretion existing at the time the airplane exits all icing conditions. The ARAC was concerned that some future airplanes would be incapable of complying with these recommended requirements without including some means to increase the stall warning margin and airplane controllability upon detection of appendix O icing conditions. The ARAC recommended applying less stringent stall warning and controllability requirements with the ice accretion existing at the time appendix O icing conditions are detected, before the means to increase the stall warning margin and airplane controllability becomes effective.

The FAA considers these ARAC recommended requirements to add significant complexity to the proposed rule to address an issue that may not arise. The FAA considers it unlikely that future airplane designs will include means to increase the stall warning margin and airplane controllability upon detection of appendix O icing conditions in addition to the means that are incorporated in many current transport category airplane designs to change the stall warning device activation point upon activation of the ice protection system. Therefore, these ARAC recommendations are not included in this NPRM. If needed, the FAA can issue special conditions, in accordance with § 21.16, to provide adequate safety standards in the unlikely event that such design features are included in a future transport category airplane.

Another difference between this NPRM and the ARAC recommendation concerns the requirements for pilot compartment view, airspeed indication system, angle of attack system and static pressure system.[22] For these rules the ARAC recommendation would have required airplanes certified in accordance with § 25.1420(a)(1) or (a)(2) to consider all appendix O icing conditions. However, the ARAC recommended advisory circular material allowed these airplanes to consider less than the full appendix O icing conditions. The FAA is not proposing that these airplanes must meet the performance and handling qualities requirements for all of the icing conditions specified in appendix O. Therefore, for pilot compartment view, airspeed indication system, angle of attack system and static pressure system,[23] the agency concurs that it would only be necessary to show compliance under the applicable conditions in appendix O.

Discussion of Working Group Non-Consensus Issues

One goal of the ARAC process is to have a working group achieve consensus on all of the recommendations. The IPHWG did not unanimously agree on the following issues:

1. Whether it is necessary to flight test in natural SLD icing conditions.

2. Whether airplanes with certain design features should be exempt from the recommendation for § 25.1420.

[20] The complete IPHWG working group report is available on the Internet at *http://regulations.gov.* A copy will also be placed in the docket (FAA–2010–0636).

[21] A copy of the Initial Regulatory Evaluation (dated October 5, 2009) can be found in the docket (FAA–2010–0636).

[22] 14 CFR 25.773, 25.1323, 25.1324, and 25.1325.

[23] *Ibid.*

3. Whether it is acceptable to certificate an airplane to a portion of appendix O, as proposed in the recommendation for § 25.1420(a)(2).

4. Whether certain icing related accidents might have been prevented if an accident airplane had complied with the recommendations in the IPHWG report.

A detailed discussion of the IPHWG's minority and majority opinions on these issues is included in the working group report. A copy of the working group report is in the public docket.[24]

The FAA predominantly concurred with the ARAC's recommendations, but determined it was necessary to revise the applicability of the recommendation for § 25.1420, as discussed previously.

Paperwork Reduction Act

The Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) requires that the FAA consider the impact of paperwork and other information collection burdens imposed on the public. The information collection requirements associated with this NPRM have been previously approved by the Office of Management and Budget (OMB) under the provisions of the Paperwork Reduction Act of 1995 (44 U.S.C. 3507(d)) and have been assigned OMB Control Number 2120–0018.

International Compatibility

In keeping with U.S. obligations under the Convention on International Civil Aviation, it is FAA policy to comply with International Civil Aviation Organization (ICAO) Standards and Recommended Practices to the maximum extent practicable. The FAA has determined that there are no ICAO Standards and Recommended Practices that correspond to these proposed regulations.

European Aviation Safety Agency

The European Aviation Safety Agency (EASA) was established by the European Community to develop standards to ensure safety and environmental protection, oversee uniform application of those standards, and promote them internationally. EASA formally became responsible for certification of aircraft, engines, parts, and appliances on September 28, 2003. EASA has a project similar to SLD on its rulemaking inventory and our intent is to harmonize these regulations.

[24] The complete IPHWG working group report is available on the Internet at *http://regulations.gov.* The docket number is FAA–2010–0636.

Regulatory Evaluation, Regulatory Flexibility Determination, International Trade Analysis, and Unfunded Mandates

Changes to Federal regulations must undergo several economic analyses. First, Executive Order 12866 directs that each Federal agency shall propose or adopt a regulation only upon a reasoned determination that the benefits of the intended regulation justify its costs. Second, the Regulatory Flexibility Act of 1980 (Pub. L. 96–354) requires agencies to analyze the economic impact of regulatory changes on small entities. Third, the Trade Agreements Act (Pub. L. 96–39) prohibits agencies from setting standards that create unnecessary obstacles to the foreign commerce of the United States. In developing U.S. standards, this Trade Act requires agencies to consider international standards and, where appropriate, that they be the basis of U.S. standards. Fourth, the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires agencies to prepare a written assessment of the costs, benefits, and other effects of proposed or final rules that include a Federal mandate likely to result in the expenditure by State, local, or tribal governments, in the aggregate, or by the private sector, of $100 million or more annually (adjusted for inflation with base year of 1995). This portion of the preamble summarizes the FAA's analysis of the economic impacts of this proposed rule. We suggest readers seeking greater detail read the full regulatory evaluation, a copy of which we have placed in the docket for this rulemaking.

In conducting these analyses, FAA has determined that this proposed rule: (1) Has benefits that justify its costs; (2) is not an economically "significant regulatory action" as defined in section 3(f) of Executive Order 12866; (3) is "significant" as defined in DOT's Regulatory Policies and Procedures; (4) would not have a significant economic impact on a substantial number of small entities; (5) would not create unnecessary obstacles to the foreign commerce of the United States; and (6) would not impose an unfunded mandate on State, local, or tribal governments, or on the private sector by exceeding the threshold identified above. These analyses are summarized below.

Total Benefits and Costs of This Rule

This NPRM would amend the airworthiness standards applicable to certain transport category airplanes certified for flight in icing conditions and the icing airworthiness standards applicable to certain aircraft engines. The affected fleet and categories of benefits and costs are customized to the requirements contained in this proposal. So, depending on the category and type of airplane, the benefits and costs are analyzed over different time periods. It is important for the reader to focus on present value benefits and costs. The total estimated benefits are $405.6 million ($99.5 million present value). The total estimated costs are $71.0 million ($54.0 million present value). On an annualized basis, for the time period 2012–2064, the benefits are $7.0 million, and the costs are $3.8 million. Therefore, the benefits of the proposed rule justify the costs, and the proposed rule is cost beneficial.

Persons Potentially Affected by This Rule

- Part 25 airplane manufacturers.
- Engine manufacturers.
- Operators of Affected Equipment.

Assumptions

- Discount rate—7%.
- Costs and benefits are expressed in 2009 dollars and that both costs and benefits start to occur in 2011. We conservatively assume that all certifications are approved one year after the rule is codified (2011), and that production/deliveries begin to occur the following year (2012). Airplane deliveries continue to accumulate until the airplane is out of production and then begin to retire in the 25th year of service. We have customized different fleet types (smaller, medium, larger) based upon the actual historical production cycles and deliveries. The varying periods are based on all the historical data that we have available. The production cycles for smaller airplanes are shorter than the production cycles of larger airplanes, thus the differing time periods.
- Value of an Averted Fatality—$6.0 million.
- Fuel Cost per gallon—$1.92.

Benefits of This Proposed Rule

The industry, with the FAA, analyzed the SLD events for part 25 certified airplanes. We evaluated the events for applicability and preventability in context with the requirements contained in this proposed rule.

First, we develop an annual risk of a catastrophic SLD event per aircraft and assume a uniform annual likelihood. Next, we multiply the total annual affected aircraft by the annual risk per aircraft. Lastly, we multiply the total annual risk by the estimated cost of an average SLD event. When summed over time, the total estimated benefits are

$405.6 million ($99.5 million present value).

Costs of This Proposed Rule

The total estimated costs are $71.0 million ($54.0 million present value). We obtained the basis of our cost estimates from the industry. The manufacturers used accompanying advisory circulars (AC) describing acceptable means for showing compliance. The compliance costs are analyzed in context of the part 25 and part 33 certification requirements.

The FAA originally asked ARAC to estimate other operational costs beyond the additional hardware and fuel consumption costs. The additional hardware costs would be for SLD ice detectors that manufacturers would install to be in compliance with the proposed requirements. The additional hardware costs would be accompanied by additional fuel consumption costs from the accompanying weight changes due to the SLD ice detectors. Accordingly, ARAC provided this data to the FAA. However, as we neared completion of our cost analysis for these requirements, we queried individual operators and they informed us that they were already in compliance and there were no additional operational costs beyond fuel and hardware.

As summarized below, the cost categories in the regulatory evaluation incorporate both certification and operational costs. We analyze each cost category separately. The cost categories in this evaluation are the same as those provided by industry to comply with the requirements contained in this proposal. For this analysis, the estimated costs were:

	Nominal Cost	PV Cost
Engine Cert Cost	$7,936,000	$6,931,610
Engine Capital Cost	6,000,000	5,240,632
Total Engine	13,936,000	12,172,242
Small Aircraft Certification Cost	24,999,039	21,835,129
New Large Aircraft Certification Cost	3,154,600	2,755,350
Amended Type Certificate Large Airplane Certification Cost	10,438,800	9,117,652
Hardware Costs	10,390,000	5,842,024
Fuel Burn All	8,046,676	2,261,941
Total	70,965,115	53,984,338

Alternatives Considered

Alternative 1—Make all sizes of aircraft applicable to the proposal. Not all the requirements in this proposal extend to larger transport category aircraft (those with a maximum takeoff weight greater than 60,000 pounds). Under this alternative, the proposed design requirements would extend to all transport category aircraft. This alternative was rejected because this alternative would add significant cost without a commensurate increase in benefits.

Alternative 2—Limit the scope of applicability to small aircraft. Although this alternative would decrease the estimated cost, the FAA believes that medium airplanes have the same risk as small airplanes. The FAA does not want a significant proportion of the future fleet to be disproportionately at risk.

Regulatory Flexibility Determination

The Regulatory Flexibility Act of 1980 (Pub. L. 96–354) (RFA) establishes "as a principle of regulatory issuance that agencies shall endeavor, consistent with the objectives of the rule and of applicable statutes, to fit regulatory and informational requirements to the scale of the businesses, organizations, and governmental jurisdictions subject to regulation. To achieve this principle, agencies are required to solicit and consider flexible regulatory proposals and to explain the rationale for their actions to assure that such proposals are given serious consideration." The RFA covers a wide-range of small entities, including small businesses, not-for-profit organizations, and small governmental jurisdictions.

Agencies must perform a review to determine whether a rule will have a significant economic impact on a substantial number of small entities. If the agency determines that it will, the agency must prepare a regulatory flexibility analysis as described in the RFA.

However, if an agency determines that a rule is not expected to have a significant economic impact on a substantial number of small entities, section 605(b) of the RFA provides that the head of the agency may so certify and a regulatory flexibility analysis is not required. The certification must include a statement providing the factual basis for this determination, and the reasoning should be clear. Based on the analysis presented below, we determined there would not be a significant impact on a substantial number of small entities.

Airplane and Engine Manufacturers

Aircraft and Engine Manufacturers would be affected by the requirements contained in this proposal.

For aircraft manufacturers, we use the size standards from the Small Business Administration for Air Transportation and Aircraft Manufacturing specifying companies having less than 1,500 employees as small entities. The current United States part 25 airplane manufacturers include: Boeing, Cessna Aircraft, Gulfstream Aerospace, Learjet (owned by Bombardier), Lockheed Martin, McDonnell Douglas (a wholly-owned subsidiary of The Boeing Company), Raytheon Aircraft, and Sabreliner Corporation. Because all U.S. transport-aircraft category manufacturers have more than 1,500 employees, none are considered small entities.

United States aircraft engine manufacturers include: General Electric, CFM International, Pratt & Whitney, International Aero Engines, Rolls-Royce Corporation, Honeywell, and Williams International. All but one exceeds the Small Business Administration small-entity criteria for aircraft engine manufacturers. Williams International is the only one of these manufacturers that is a U.S. small business. One small entity is not a substantial number.

Operators

In addition to the certification cost incurred by manufacturers, operators would incur fuel costs due to the estimated additional impact of weight changes from equipment on affected airplanes. On average, an affected airplane would incur additional fuel costs of roughly $525 per year.

Because this proposed rule would apply to airplanes that have yet to be designed, there would be no immediate cost to small entities. However, as of 2007, there are at least 54 small entity operators with 1,500 or fewer employees who would qualify as small entities.

According to the "Airliner Price Guide," the average cost of a new aircraft that would incur such expenses is approximately $17 million. The corresponding 3-year average total aircraft operating expenses on an affected per airplane basis was $758,000. The estimated additional cost of $525 would add only 0.07% to the total annual operating expenses. We do not consider this a significant economic impact.

Because this proposed rule would not have a significant economic impact on a substantial number of airplane manufacturers, engine manufacturers or operators, the FAA certifies that this proposed rule would not have a significant economic impact on a substantial number of small entities. The FAA solicits comments regarding this determination.

International Trade Analysis

The Trade Agreements Act of 1979 (Pub. L. 96–39), as amended by the Uruguay Round Agreements Act (Pub. L. 103–465), prohibits Federal agencies from establishing standards or engaging in related activities that create unnecessary obstacles to the foreign commerce of the United States. Pursuant to these Acts, the establishment of standards is not considered an unnecessary obstacle to the foreign commerce of the United States, so long as the standard has a legitimate domestic objective, such the protection of safety, and does not operate in a manner that excludes imports that meet this objective. The statute also requires consideration of international standards and, where appropriate, that they be the basis for U.S. standards.

The FAA has assessed the potential effect of this proposed rule and determined that it would impose the same costs on domestic and international entities and thus has a neutral trade impact.

Unfunded Mandates Assessment

Title II of the Unfunded Mandates Reform Act of 1995 (Pub. L. 104–4) requires each Federal agency to prepare a written statement assessing the effects of any Federal mandate in a proposed or final agency rule that may result in an expenditure of $100 million or more (in 1995 dollars) in any one year by State, local, and tribal governments, in the aggregate, or by the private sector; such a mandate is deemed to be a "significant regulatory action." The FAA currently uses an inflation-adjusted value of $143.1 million in lieu of $100 million. This proposed rule does not contain such a mandate; therefore, the requirements of Title II do not apply.

Executive Order 13132, Federalism

The FAA has analyzed this proposed rule under the principles and criteria of Executive Order 13132, Federalism. We determined that this action would not have a substantial direct effect on the States, on the relationship between the national Government and the States, or on the distribution of power and responsibilities among the various levels of government, and, therefore, would not have federalism implications.

Regulations Affecting Intrastate Aviation in Alaska

Section 1205 of the FAA Reauthorization Act of 1996 (110 Stat. 3213) requires the Administrator, when modifying regulations in Title 14 of the CFR in a manner affecting intrastate aviation in Alaska, to consider the extent to which Alaska is not served by transportation modes other than aviation, and to establish appropriate regulatory distinctions. Because this proposed rule would apply to the certification of future designs of transport category airplanes and their subsequent operation, it could, if adopted, affect intrastate aviation in Alaska. The FAA, therefore, specifically requests comments on whether there is justification for applying the proposed rule differently in intrastate operations in Alaska.

Environmental Analysis

FAA Order 1050.1E identifies FAA actions that are categorically excluded from preparation of an environmental assessment or environmental impact statement under the National Environmental Policy Act in the absence of extraordinary circumstances. The FAA has determined this proposed rulemaking action qualifies for the categorical exclusion identified in paragraph 4(j) and involves no extraordinary circumstances.

Regulations That Significantly Affect Energy Supply, Distribution, or Use

The FAA has analyzed this NPRM under Executive Order 13211, Actions Concerning Regulations that Significantly Affect Energy Supply, Distribution, or Use (May 18, 2001). We have determined that it is not a "significant energy action" under the executive order because, while it is a "significant regulatory action," it is not likely to have a significant adverse effect on the supply, distribution, or use of energy.

Plain English

Executive Order 12866 (58 FR 51735, Oct. 4, 1993) requires each agency to write regulations that are simple and easy to understand. We invite your comments on how to make these proposed regulations easier to understand, including answers to questions such as the following:

- Are the requirements in the proposed regulations clearly stated?
- Do the proposed regulations contain unnecessary technical language or jargon that interferes with their clarity?
- Would the regulations be easier to understand if they were divided into more (but shorter) sections?
- Is the description in the preamble helpful in understanding the proposed regulations?

Please send your comments to the address specified in the **ADDRESSES** section of this preamble.

Additional Information

Comments Invited

The FAA invites interested persons to participate in this rulemaking by submitting written comments, data, or views. We also invite comments relating to the economic, environmental, energy, or federalism impacts that might result from adopting the proposals in this document. The most helpful comments reference a specific portion of the proposal, explain the reason for any recommended change, and include supporting data. To ensure the docket does not contain duplicate comments, please send only one copy of written comments, or if you are filing comments electronically, please submit your comments only one time.

We will file in the docket all comments we receive, as well as a report summarizing each substantive public contact with FAA personnel concerning this proposed rulemaking. Before acting on this proposal, we will consider all comments we receive on or before the closing date for comments. We will consider comments filed after the comment period has closed if it is possible to do so without incurring expense or delay. We may change this proposal in light of the comments we receive.

Proprietary or Confidential Business Information

Do not file in the docket information that you consider to be proprietary or confidential business information. Send or deliver this information directly to the person identified in the **FOR FURTHER INFORMATION CONTACT** section of this document. You must mark the information that you consider proprietary or confidential. If you send the information on a disk or CD ROM, mark the outside of the disk or CD ROM and also identify electronically within the disk or CD ROM the specific information that is proprietary or confidential.

Under 14 CFR 11.35(b), when we are aware of proprietary information filed with a comment, we do not place it in the docket. We hold it in a separate file to which the public does not have access, and we place a note in the docket that we have received it. If we receive a request to examine or copy this information, we treat it as any other request under the Freedom of Information Act (5 U.S.C. 552). We process such a request under the DOT procedures found in 49 CFR part 7.

Availability of Rulemaking Documents

You can get an electronic copy of rulemaking documents using the Internet by—

1. Searching the Federal eRulemaking Portal (*http://www.regulations.gov*);

2. Visiting the FAA's Regulations and Policies web page at *http://www.faa.gov/regulations_policies/*; or

3. Accessing the Government Printing Office's web page at *http://www.gpoaccess.gov/fr/index.html.*

You can also get a copy by sending a request to the Federal Aviation Administration, Office of Rulemaking, ARM–1, 800 Independence Avenue, SW., Washington, DC 20591, or by calling (202) 267–9680. Make sure to identify the docket number or notice number of this rulemaking.

You may access all documents the FAA considered in developing this proposed rule, including economic analyses and technical reports, from the internet through the Federal eRulemaking Portal referenced in paragraph (1).

The following appendix will not appear in the Code of Federal Regulations.

Appendix 1 to the Preamble—Definition of Terms Used in This Preamble

For the purposes of this preamble, the following definitions are applicable. These definitions of terms are intended for use only with this preamble:

a. *Appendix C Icing Conditions:* The environmental conditions defined in appendix C of 14 CFR part 25.

b. *Appendix O Icing Conditions:* The environmental conditions defined in appendix O of 14 CFR part 25.

c. *Drizzle Drop:* A drop of water measuring 100 μm to 500 μm (0.1–0.5 mm) in diameter.

d. *Freezing Drizzle (FZDZ):* Supercooled drizzle drops that remain in liquid form and freeze upon contact with objects colder than 0°C.

e. *Freezing Rain (FZRA):* Supercooled rain drops that remain in liquid form and freeze upon contact with objects colder than 0°C.

f. *Icing Conditions:* The presence of atmospheric moisture and temperature conducive to airplane icing.

g. *Icing Conditions Detector:* A device that detects the presence of atmospheric moisture and temperature conducive to airplane icing.

h. *Irreversible Flight Controls:* Flight controls in the normal operating configuration that have loads generated at the control surfaces of an airplane which are reacted against the actuator and its mounting and cannot be transmitted directly back to the flight deck controls. This term refers to flight controls in which all of the force necessary to move the pitch, roll, or yaw control surfaces is provided by hydraulic or electric actuators, the motion of which is controlled by signals from the flight deck controls.

i. *Liquid Water Content (LWC):* The total mass of water contained in liquid drops within a unit volume or mass of air, usually given in units of grams of water per cubic meter (g/m^3).

j. *Mean Effective Diameter (MED):* The calculated drop diameter that divides the total liquid water content present in the drop size distribution in half. Half the water volume will be in larger drops and half the volume in smaller drops. This value is calculated, as opposed to being arrived at by measuring actual drop size. The MED is based on an assumed Langmuir drop size distribution. The fact that it is a calculated measurement is how it differs from median volume diameter, which is based on actual drop size.

k. *Median Volume Diameter (MVD):* The drop diameter that divides the total liquid water content present in the drop distribution in half. Half the water volume will be in larger drops and half the volume in smaller drops. The value is obtained by actual drop size measurements.

l. *Mixed Phase Icing Environment:* A combination of supercooled liquid and ice crystals.

m. *Rain Drop:* A drop of water greater than 500 μm (0.5 mm) in diameter.

n. *Reversible Flight Controls:* Flight controls in the normal operating configuration that have force or motion originating at the airplane's control surface (for example, through aerodynamic loads, static imbalance, or trim tab inputs) that is transmitted back to flight deck controls. This term refers to flight deck controls connected to the pitch, roll, or yaw control surfaces by direct mechanical linkages, cables, or push-pull rods in such a way that pilot effort produces motion or force about the hinge line.

(1) Aerodynamically boosted flight controls: Reversible flight control systems that employ a movable tab on the trailing edge of the main control surface linked to the pilot's controls or to the structure in such a way as to produce aerodynamic forces that move, or help to move, the surface. Among the various forms are flying tabs, geared or servo tabs, and spring tabs.

(2) Power-assisted flight controls: Reversible flight control systems in which some means is provided, usually a hydraulic actuator, to apply force to a control surface in addition to that supplied by the pilot to enable large surface deflections to be obtained at high speeds.

o. *Supercooled Large Drops (SLD):* Supercooled liquid water that includes freezing rain or freezing drizzle.

p. *Supercooled Water:* Liquid water at a temperature below the freezing point of 0°C.

List of Subjects

14 CFR Part 25

Aircraft, Aviation safety, Reporting and recordkeeping requirements, Safety, Transportation.

14 CFR Part 33

Aircraft, Aviation safety.

The Proposed Amendment

In consideration of the foregoing, the Federal Aviation Administration proposes to amend Chapter I of Title 14, Code of Federal Regulations parts 25 and 33 as follows:

PART 25—AIRWORTHINESS STANDARDS: TRANSPORT CATEGORY AIRPLANES

1. The authority citation for part 25 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702 and 44704.

2. Amend § 25.21 by revising paragraphs (g)(1) and (g)(2) and adding paragraphs (g)(3) and (g)(4) to read as follows:

§ 25.21 Proof of compliance.

* * * * *

(g) * * *

(1) Paragraphs (g)(3) and (g)(4) of this section apply only to airplanes with one or both of the following attributes:

(i) Takeoff maximum gross weight is less than 60,000 lbs; or

(ii) The airplane is equipped with reversible flight controls.

(2) Each requirement of this subpart, except §§ 25.121(a), 25.123(c), 25.143(b)(1) and (2), 25.149, 25.201(c)(2), 25.207(c) and (d), 25.239, and 25.251(b) through (e), must be met in the icing conditions specified in appendix C of this part. Compliance must be shown using the ice accretions defined in part II of appendix C of this part, assuming normal operation of the airplane and its ice protection system in accordance with the operating limitations and operating procedures established by the applicant and provided in the Airplane Flight Manual.

(3) If the applicant does not seek certification for flight in all icing conditions defined in appendix O of this part, each requirement of this subpart, except §§ 25.105, 25.107, 25.109, 25.111, 25.113, 25.115, 25.121, 25.123, 25.143(b)(1), (b)(2), and (c)(1), 25.149, 25.201(c)(2), 25.207(c) and (d), 25.239, and 25.251(b) through (e), must be met in the appendix O icing conditions for which certification is not sought in order to allow a safe exit from those conditions. Compliance must be shown using the ice accretions defined in part II, paragraphs (b) and (d) of appendix O of this part, assuming normal operation of the airplane and its ice protection system in accordance with the operating limitations and operating procedures established by the applicant and provided in the Airplane Flight Manual.

(4) If the applicant seeks certification for flight in any portion of the icing conditions of appendix O of this part, each requirement of this subpart, except §§ 25.123(c), 25.143(b)(1) and (2), 25.149, 25.201(c)(2), 25.207(c) and (d), 25.239, and 25.251(b) through (e), must be met in the appendix O icing conditions for which certification is sought. Compliance must be shown using the ice accretions defined in part II, paragraphs (c) and (d) of appendix O of this part, assuming normal operation of the airplane and its ice protection system in accordance with the operating limitations and operating procedures established by the applicant and provided in the Airplane Flight Manual.

3. Amend § 25.105 by revising paragraph (a)(2) introductory text to read as follows:

§ 25.105 Takeoff.

(a) * * *

(2) In icing conditions, if in the configuration used to show compliance with § 25.121(b), and with the most critical of the takeoff ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g):

* * * * *

4. Amend § 25.111 by revising paragraphs (c)(5)(i) and (c)(5)(ii) to read as follows:

§ 25.111 Takeoff path.

* * * * *

(c) * * *

(5) * * *

(i) With the most critical of the takeoff ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), from a height of 35 feet above the takeoff surface up to the point where the airplane is 400 feet above the takeoff surface; and

(ii) With the most critical of the final takeoff ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), from the point where the airplane is 400 feet above the takeoff surface to the end of the takeoff path.

* * * * *

5. Amend § 25.119 by revising paragraph (b) to read as follows:

§ 25.119 Landing climb: All-engines-operating.

* * * * *

(b) In icing conditions with the most critical of the landing ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), and with a climb speed of V_{REF} determined in accordance with § 25.125(b)(2)(ii).

6. Amend § 25.121 by revising paragraphs (b)(2)(ii) introductory text, (c)(2)(ii) introductory text, and (d)(2)(ii) to read as follows:

§ 25.121 Climb: One-engine-inoperative.

* * * * *

(b) * * *

(2) * * *

(ii) In icing conditions with the most critical of the takeoff ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), if in the configuration used to show compliance with § 25.121(b) with this takeoff ice accretion:

* * * * *

(c) * * *

(2) * * *

(ii) In icing conditions with the most critical of the final takeoff ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), if in the configuration used to show compliance with § 25.121(b) with the takeoff ice accretion used to show compliance with § 25.111(c)(5)(i):

* * * * *

(d) * * *

(2) * * *

(ii) In icing conditions with the most critical of the approach ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g). The climb speed selected for non-icing conditions may be used if the climb speed for icing conditions, computed in accordance with paragraph (d)(1)(iii) of this section, does not exceed that for non-icing conditions by more than the greater of 3 knots CAS or 3 percent.

7. Amend § 25.123 by revising paragraph (b)(2) introductory text to read as follows:

§ 25.123 En-route flight paths.

* * * * *

(b) * * *

(2) In icing conditions with the most critical of the en route ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), if:

* * * * *

8. Amend § 25.125 by revising paragraphs (a)(2), (b)(2)(ii)(B), and (b)(2)(ii)(C) to read as follows:

§ 25.125 Landing.

(a) * * *

(2) In icing conditions with the most critical of the landing ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), if V_{REF} for icing conditions exceeds V_{REF} for non-icing conditions by more than 5 knots CAS at the maximum landing weight.

(b) * * *

(2) * * *

(ii) * * *

(B) 1.23 V_{SR0} with the most critical of the landing ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), if that speed exceeds V_{REF} selected for non-icing conditions by more than 5 knots CAS; and

(C) A speed that provides the maneuvering capability specified in § 25.143(h) with the most critical of the landing ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g).

* * * * *

9. Amend § 25.143 by revising paragraphs (c) introductory text, (i)(1), and (j) introductory text to read as follows:

§ 25.143 Controllability and maneuverability—General.

* * * * *

(c) The airplane must be shown to be safely controllable and maneuverable with the most critical of the ice accretion(s) appropriate to the phase of flight as defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), and with the critical engine inoperative and its propeller (if applicable) in the minimum drag position:

* * * * *

(i) * * *

(1) Controllability must be demonstrated with the most critical of the ice accretion(s) for the particular flight phase as defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g);

* * * * *

(j) For flight in icing conditions before the ice protection system has been activated and is performing its intended function, it must be demonstrated in flight with the most critical of the ice accretion(s) defined in appendix C, part II, paragraph (e) of this part and appendix O, part II, paragraph (d) of this part, as applicable, in accordance with § 25.21(g), that:

* * * * *

10. Amend § 25.207 by revising paragraphs (b), (e)(1) through (5), and (h) introductory text to read as follows:

§ 25.207 Stall warning.

* * * * *

(b) The warning must be furnished either through the inherent aerodynamic qualities of the airplane or by a device that will give clearly distinguishable indications under expected conditions of flight. However, a visual stall warning device that requires the attention of the crew within the cockpit is not acceptable by itself. If a warning device is used, it must provide a warning in each of the airplane configurations prescribed in paragraph (a) of this section at the speed prescribed in paragraphs (c) and (d) of this section. Except for the stall warning prescribed in paragraph (h)(3)(ii) of this section, the stall warning for flight in icing conditions must be provided by the same means as the stall warning for flight in non-icing conditions.

* * * * *

(e) * * *

(1) The most critical of the takeoff ice and final takeoff ice accretions defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), for each configuration used in the takeoff phase of flight;

(2) The most critical of the en route ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), for the en route configuration;

(3) The most critical of the holding ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), for the holding configuration(s);

(4) The most critical of the approach ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), for the approach configuration(s); and

(5) The most critical of the landing ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), for the landing and go-around configuration(s).

* * * * *

(h) The following stall warning margin is required for flight in icing conditions before the ice protection system has been activated and is performing its intended function. Compliance must be shown using the most critical of the ice accretion(s) defined in appendix C, part II, paragraph (e) of this part and appendix O, part II, paragraph (d) of this part, as applicable, in accordance with § 25.21(g). The stall warning margin in straight and turning flight must be sufficient to allow the pilot to prevent stalling without encountering any adverse flight characteristics when:

* * * * *

11. Amend § 25.237 by revising paragraph (a)(3)(ii) to read as follows:

§ 25.237 Wind velocities.

(a) * * *

(3) * * *

(ii) Icing conditions with the most critical of the landing ice accretion(s) defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g).

* * * * *

12. Amend § 25.253 by revising paragraph (c) introductory text to read as follows:

§ 25.253 High-speed characteristics.

* * * * *

(c) *Maximum speed for stability characteristics in icing conditions.* The maximum speed for stability characteristics with the most critical of the ice accretions defined in appendices C and O of this part, as applicable, in accordance with § 25.21(g), at which the requirements of §§ 25.143(g), 25.147(e), 25.175(b)(1), 25.177 and 25.181 must be met, is the lower of:

* * * * *

13. Amend § 25.773 by revising paragraph (b)(1)(ii) to read as follows:

§ 25.773 Pilot compartment view.

* * * * *

(b) * * *

(1) * * *

(ii) The icing conditions specified in appendix C and the following icing conditions specified in appendix O of this part, if certification for flight in icing conditions is sought:

(A) For airplanes certificated in accordance with § 25.1420(a)(1), the icing conditions that the airplane is certified to safely exit following detection.

(B) For airplanes certificated in accordance with § 25.1420(a)(2), the icing conditions that the airplane is certified to safely operate in and the icing conditions that the airplane is certified to safely exit following detection.

(C) For airplanes certificated in accordance with § 25.1420(a)(3) and for airplanes not subject to § 25.1420, all icing conditions.

* * * * *

14. Amend § 25.903 by adding paragraph (a)(3) to read as follows:

§ 25.903 Engines.

(a) * * *

(3) Each turbine engine must comply with one of the following paragraphs:

(i) Section 33.68 of this chapter in effect on [effective date of final rule], or as subsequently amended; or

(ii) Section 33.68 of this chapter in effect on February 23, 1984, or as subsequently amended before [effective date of final rule], unless that engine's ice accumulation service history has resulted in an unsafe condition; or

(iii) Section 33.68 of this chapter in effect on October 1, 1974, or as subsequently amended prior to February 23, 1984, unless that engine's ice accumulation service history has resulted in an unsafe condition; or

(iv) Be shown to have an ice accumulation service history in similar installation locations which has not resulted in any unsafe conditions.

* * * * *

15. Amend § 25.929 by revising paragraph (a) to read as follows:

§ 25.929 Propeller deicing.

(a) If certification for flight in icing is sought there must be a means to prevent or remove hazardous ice accumulations that could form in the icing conditions defined in appendices C and O of this part on propellers or on accessories where ice accumulation would jeopardize engine performance.

* * * * *

16. Amend § 25.1093 by revising paragraph (b) to read as follows:

§ 25.1093 Induction system icing protection.

* * * * *

(b) *Turbine engines.* Each engine, with all icing protection systems operating, must:

(1) Operate throughout its flight power range, including the minimum descent idling speeds, in the icing

conditions defined in appendices C and O of this part, and appendix D of part 33 of this chapter, and in falling and blowing snow within the limitations established for the airplane for such operation, without the accumulation of ice on the engine, inlet system components or airframe components that would do any of the following:

(i) Adversely affect installed engine operation or cause a sustained loss of power or thrust; or an unacceptable increase in gas path operating temperature; or an airframe/engine incompatibility; or

(ii) Result in unacceptable temporary power loss or engine damage; or

(iii) Cause a stall, surge, or flameout or loss of engine controllability (for example, rollback).

(2) Idle for a minimum of 30 minutes on the ground in the following icing conditions shown in Table 1, unless replaced by similar test conditions that are more critical. These conditions must be demonstrated with the available air bleed for icing protection at its critical condition, without adverse effect, followed by an acceleration to takeoff power or thrust. During the idle operation the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator. The applicant must document the engine run-up procedure (including the maximum time interval between run-ups from idle, run-up power setting, and duration at power) and associated minimum ambient temperature demonstrated for the maximum time interval, and these conditions must be used in establishing the airplane operating limitations in accordance with § 25.1521.

TABLE 1—ICING CONDITIONS FOR GROUND TESTS

Condition	Total air temperature	Water concentration (minimum)	Mean effective particle diameter	Demonstration
(i) Rime ice condition	0 to 15 °F (−18 to −9 °C).	Liquid—0.3 g/m³	15–25 microns	By test, analysis or combination of the two.
(ii) Glaze ice condition	20 to 30 °F (−7 to −1 °C).	Liquid—0.3 g/m³	15–25 microns	By test, analysis or combination of the two.
(iii) Large drop condition	15 to 30 °F (−9 to −1 °C).	Liquid—0.3 g/m³	100 microns (minimum)	By test, analysis or combination of the two.

* * * * *

17. Amend § 25.1323 by revising paragraph (i) to read as follows:

§ 25.1323 Airspeed indicating system.

* * * * *

(i) Each system must have a heated pitot tube or an equivalent means of preventing malfunction in mixed phase and ice crystal conditions as defined in Table 1 of this section, the icing conditions defined in appendix C of this part, and the following icing conditions specified in appendix O of this part:

(1) For airplanes certificated in accordance with § 25.1420(a)(1), the icing conditions that the airplane is certified to safely exit following detection.

(2) For airplanes certificated in accordance with § 25.1420(a)(2), the icing conditions that the airplane is certified to safely operate in and the icing conditions that the airplane is certified to safely exit following detection.

(3) For airplanes certificated in accordance with § 25.1420(a)(3) and for airplanes not subject to § 25.1420, all icing conditions.

TABLE 1—ICING CONDITIONS FOR AIRSPEED INDICATING SYSTEM TESTS

Air temperature	Altitude range		Ice water content	Liquid water content	Horizontal extent		Ice median mass dimension	Liquid water MVD
(°C)	(ft)	(m)	g/m³	g/m³	(km)	(n miles)	(µm)	(µm)
0 to −20	10,000 to 30,000	3,000 to 9,000	4	1	5	3	100 to 1,000	20
			1	1	100	50		
			0.5	0.5	500	300		
−20 to −40	15,000 to 40,000	4,500 to 12,000	5	0	5	3		
			2	0	20	10		
			1	0	100	50		
			0.5	0	500	300		

* * * * *

18. Add § 25.1324 to read as follows:

§ 25.1324 Angle of attack system.

Each angle of attack system sensor must be heated or have an equivalent means of preventing malfunction in the mixed phase and ice crystal conditions as defined in § 25.1323, the icing conditions defined in appendix C of this part, and the following icing conditions specified in appendix O of this part:

(a) For airplanes certificated in accordance with § 25.1420(a)(1), the icing conditions that the airplane is certified to safely exit following detection.

(b) For airplanes certificated in accordance with § 25.1420(a)(2), the icing conditions that the airplane is certified to safely operate in and the icing conditions that the airplane is certified to safely exit following detection.

(c) For airplanes certificated in accordance with § 25.1420(a)(3) and for airplanes not subject to § 25.1420, all icing conditions.

19. Amend § 25.1325 by revising paragraph (b) to read as follows:

§ 25.1325 Static pressure systems.

* * * * *

(b) Each static port must be designed and located so that:

(1) The static pressure system performance is least affected by airflow variation, or by moisture or other foreign matter, and

(2) The correlation between air pressure in the static pressure system and true ambient atmospheric static pressure is not changed when the

airplane is exposed to the icing conditions defined in appendix C of this part, and the following icing conditions specified in appendix O of this part:

(i) For airplanes certificated in accordance with § 25.1420(a)(1), the icing conditions that the airplane is certified to safely exit following detection.

(ii) For airplanes certificated in accordance with § 25.1420(a)(2), the icing conditions that the airplane is certified to safely operate in and the icing conditions that the airplane is certified to safely exit following detection.

(iii) For airplanes certificated in accordance with § 25.1420(a)(3) and for airplanes not subject to § 25.1420, all icing conditions.

* * * * *

20. Add § 25.1420 to read as follows:

§ 25.1420 Supercooled large drop icing conditions.

(a) If certification for flight in icing conditions is sought, in addition to the requirements of § 25.1419, an airplane with a maximum takeoff weight less than 60,000 pounds or with reversible flight controls must be capable of operating in accordance with paragraphs (a)(1), (2), or (3), of this section.

(1) Operating safely after encountering the icing conditions defined in appendix O of this part:

(i) There must be a means provided to detect that the airplane is operating in appendix O icing conditions; and

(ii) Following detection of appendix O icing conditions, the airplane must be capable of operating safely while exiting all icing conditions.

(2) Operating safely in a portion of the icing conditions defined in appendix O of this part as selected by the applicant.

(i) There must be a means provided to detect that the airplane is operating in conditions that exceed the selected portion of appendix O icing conditions; and

(ii) Following detection, the airplane must be capable of operating safely while exiting all icing conditions.

(3) Operating safely in the icing conditions defined in appendix O of this part.

(b) To establish that the airplane can operate safely as required in paragraph (a) of this section, an analysis must be performed to establish that the ice protection for the various components of the airplane is adequate, taking into account the various airplane operational configurations. To verify the analysis, one, or more as found necessary, of the following methods must be used:

(1) Laboratory dry air or simulated icing tests, or a combination of both, of the components or models of the components.

(2) Laboratory dry air or simulated icing tests, or a combination of both, of models of the airplane.

(3) Flight tests of the airplane or its components in simulated icing conditions, measured as necessary to support the analysis.

(4) Flight tests of the airplane with simulated ice shapes.

(5) Flight tests of the airplane in natural icing conditions, measured as necessary to support the analysis.

(c) For an airplane certified in accordance with paragraph (a)(2) or (a)(3) of this section, the requirements of § 25.1419 (e), (f), (g), and (h) must be met for the icing conditions defined in appendix O of this part in which the airplane is certified to operate.

21. Amend § 25.1521 by redesignating paragraph (c)(3) as (c)(4) and revising it, and by adding new paragraph (c)(3) to read as follows:

§ 25.1521 Powerplant limitations.

* * * * *

(c) * * *

(3) Maximum time interval between engine run-ups from idle, run-up power setting, duration at power, and the associated minimum ambient temperature demonstrated for the maximum time interval, for ground operation in icing conditions, as defined in § 25.1093(b)(2).

(4) Any other parameter for which a limitation has been established as part of the engine type certificate except that a limitation need not be established for a parameter that cannot be exceeded during normal operation due to the design of the installation or to another established limitation.

* * * * *

22. Amend § 25.1533 by adding paragraph (c) to read as follows:

§ 25.1533 Additional operating limitations.

* * * * *

(c) For airplanes certified in accordance with § 25.1420(a)(1) or (a)(2), an operating limitation must be established to require exiting all icing conditions if icing conditions defined in appendix O of this part are encountered for which the airplane has not been certified to safely operate.

23. Amend part 25 by adding Appendix O to part 25 to read as follows:

Appendix O to Part 25—Supercooled Large Drop Icing Conditions

Appendix O consists of two parts. Part I defines appendix O as a description of supercooled large drop (SLD) icing conditions in which the drop median volume diameter (MVD) is less than or greater than 40 μm, the maximum mean effective drop diameter (MED) of appendix C continuous maximum (stratiform clouds) icing conditions. For appendix O, SLD icing conditions consist of freezing drizzle and freezing rain occurring in and/or below stratiform clouds. Part II defines ice accretions used to show compliance with part 25, subpart B, airplane performance and handling qualities requirements.

Part I—Meteorology

Appendix O icing conditions are defined by the parameters of altitude, vertical and horizontal extent, temperature, liquid water content, and water mass distribution as a function of drop diameter distribution.

(a) Freezing Drizzle (Conditions with spectra maximum drop diameters from 100 μm to 500 μm):

(1) Pressure altitude range: 0 to 22,000 feet MSL.

(2) Maximum vertical extent: 12,000 feet.

(3) Horizontal extent: standard distance of 17.4 nautical miles.

(4) Total liquid water content.

Note: Liquid water content (LWC) in grams per cubic meter (g/m^3) based on horizontal extent standard distance of 17.4 nautical miles.

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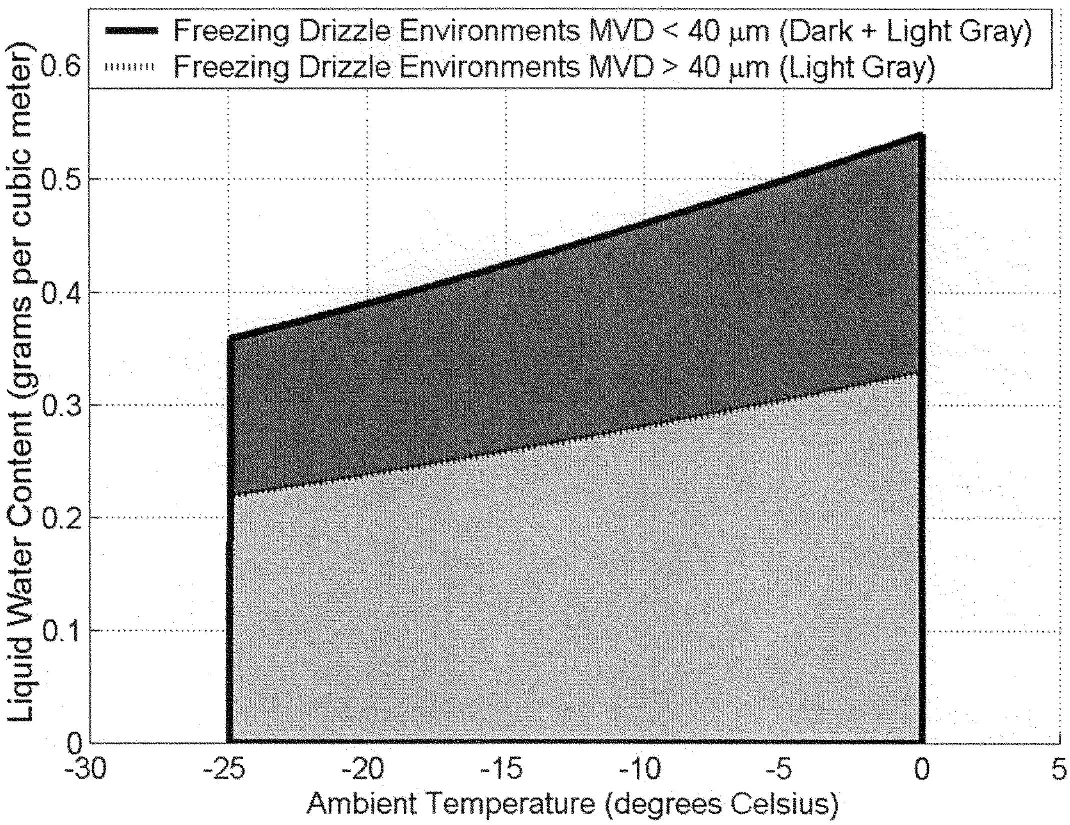
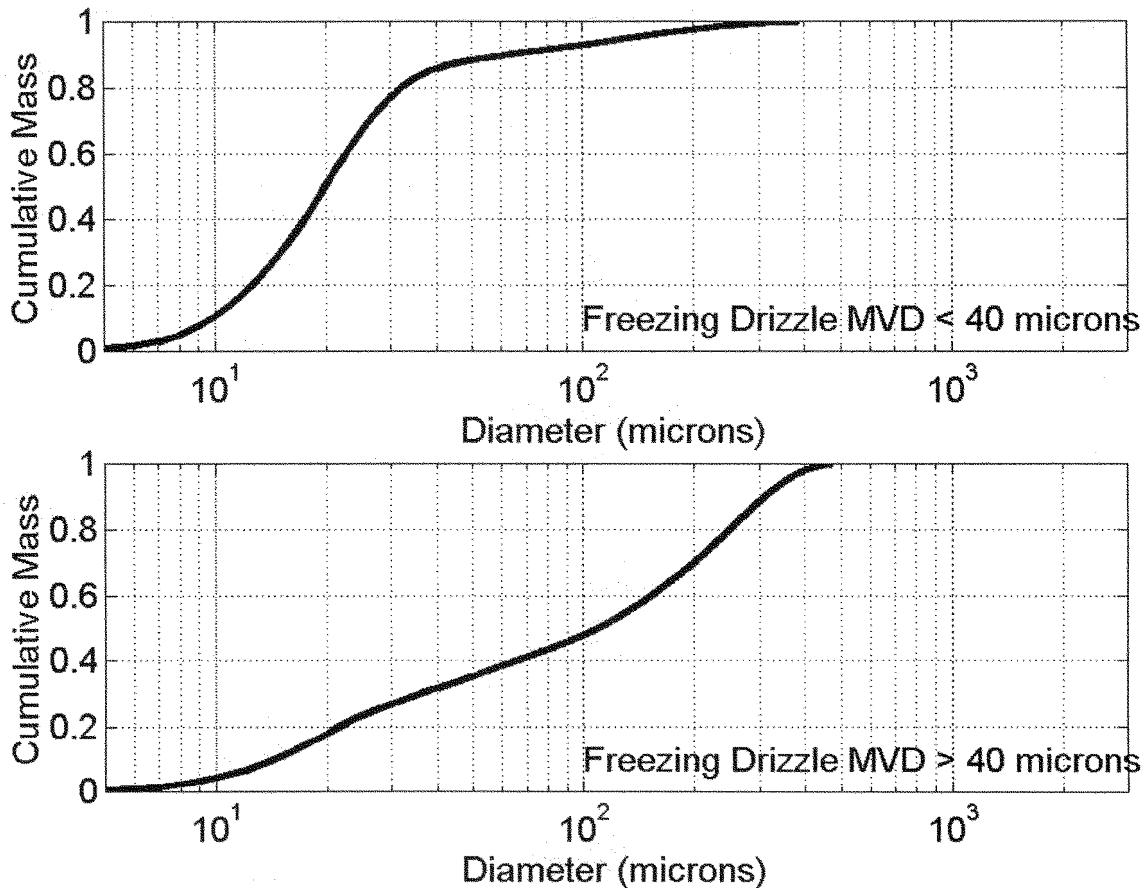
FIGURE 1 - Appendix O, Freezing Drizzle, Liquid Water Content



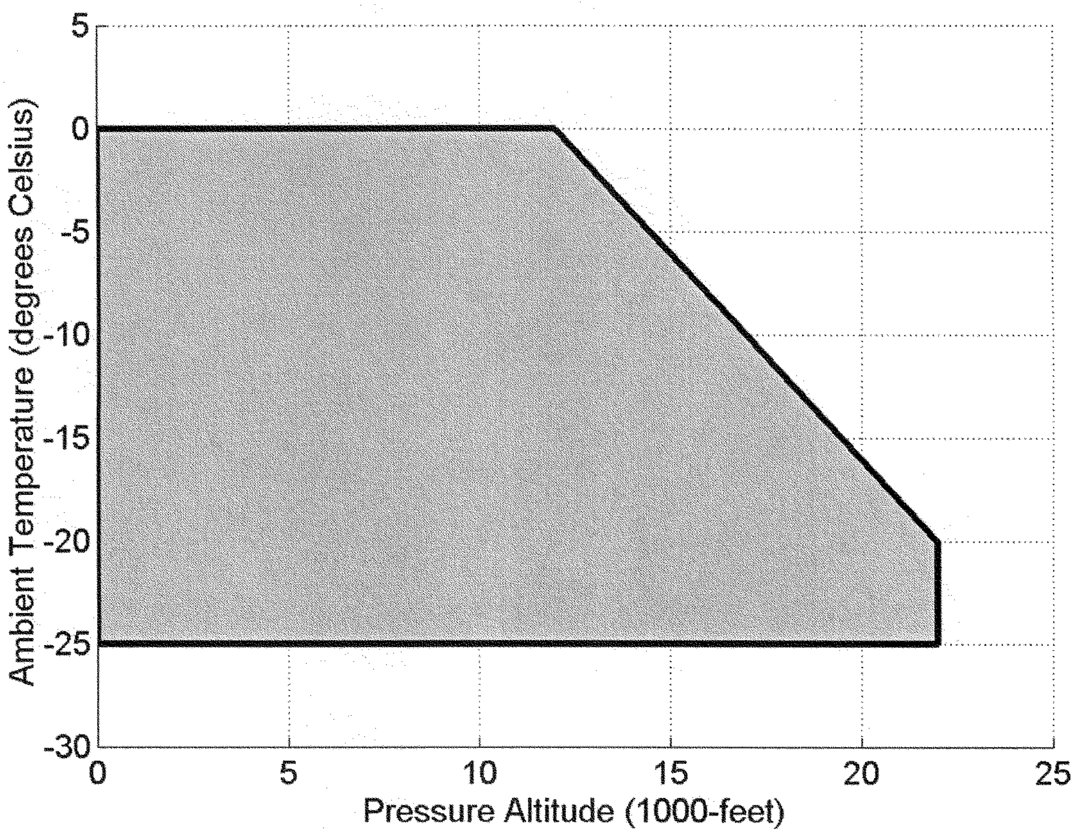
(5) Drop diameter distribution:

FIGURE 2 - Appendix O, Freezing Drizzle, Drop Diameter Distribution



(6) Altitude and temperature envelope:

FIGURE 3 - Appendix O, Freezing Drizzle, Temperature and Altitude



(b) Freezing Rain (Conditions with spectra maximum drop diameters greater than 500 μm):

(1) Pressure altitude range: 0 to 12,000 ft MSL.

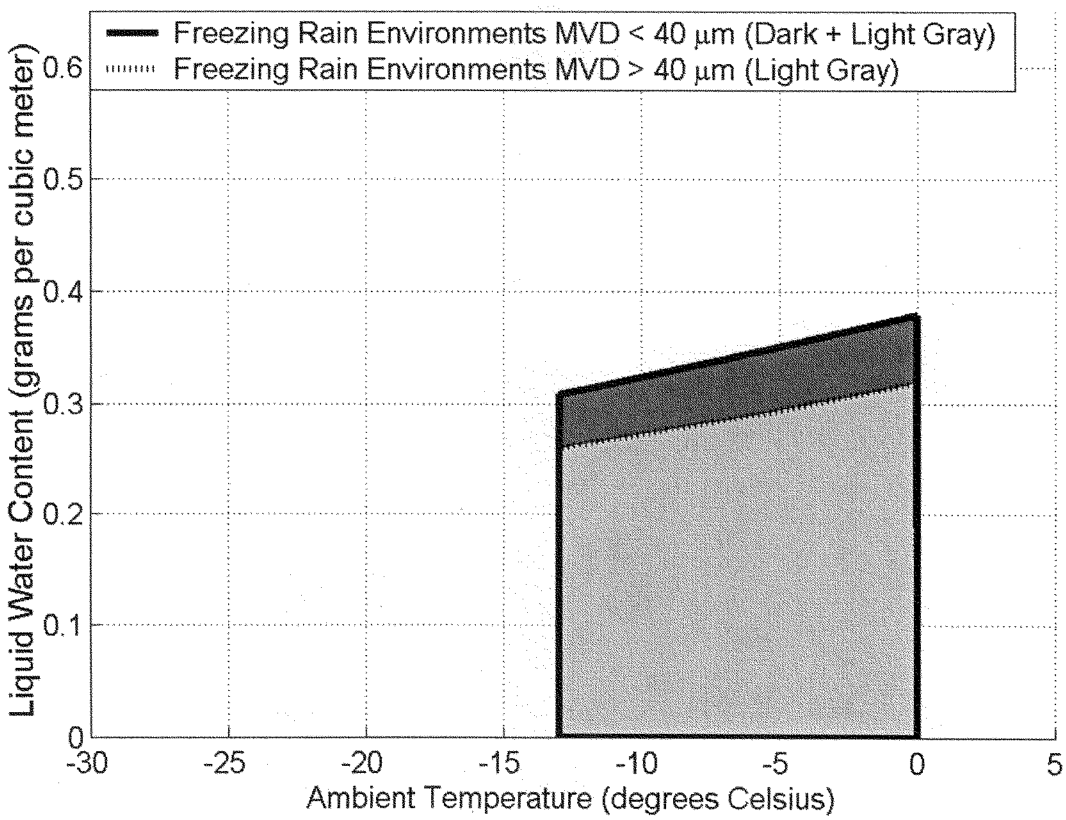
(2) Maximum vertical extent: 7,000 ft.

(3) Horizontal extent: standard distance of 17.4 nautical miles.

(4) Total liquid water content.

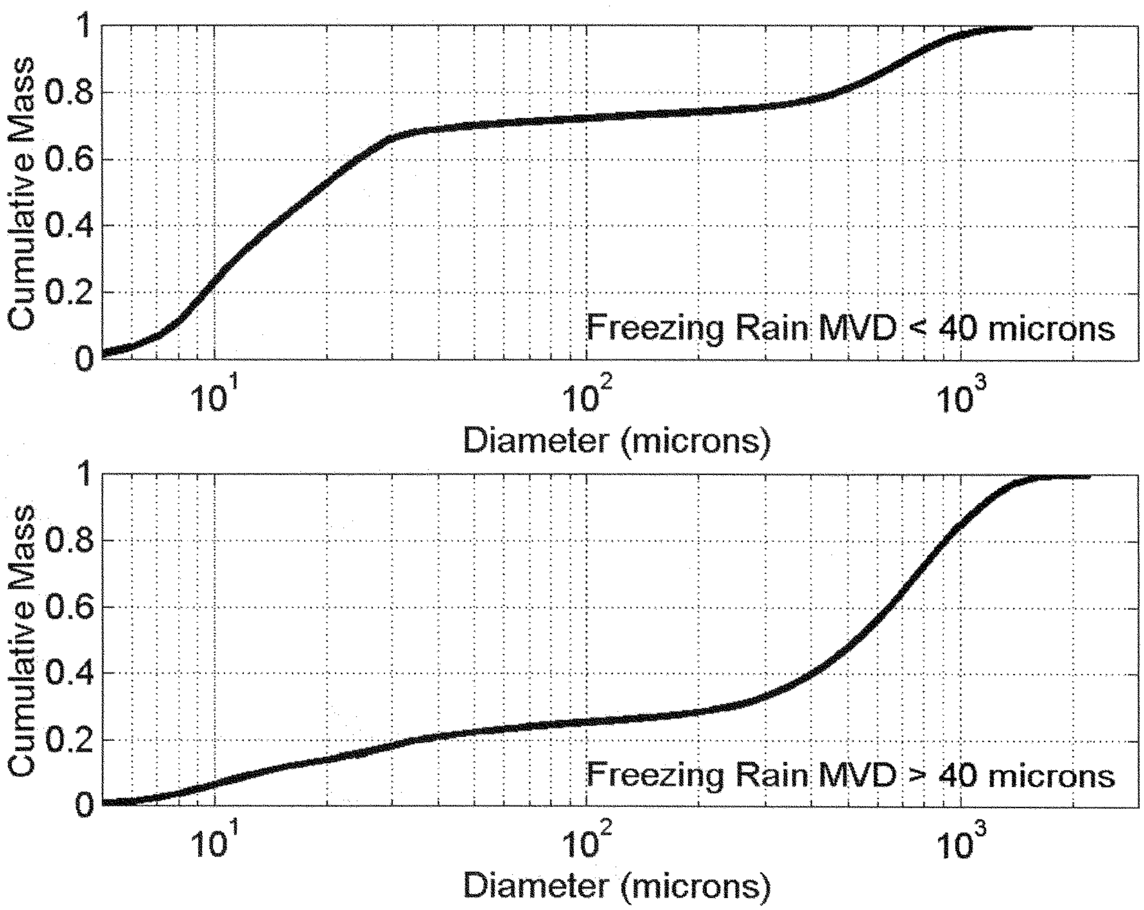
Note: LWC in grams per cubic meter (g/m^3) based on horizontal extent standard distance of 17.4 nautical miles.

FIGURE 4 - Appendix O, Freezing Rain, Liquid Water Content



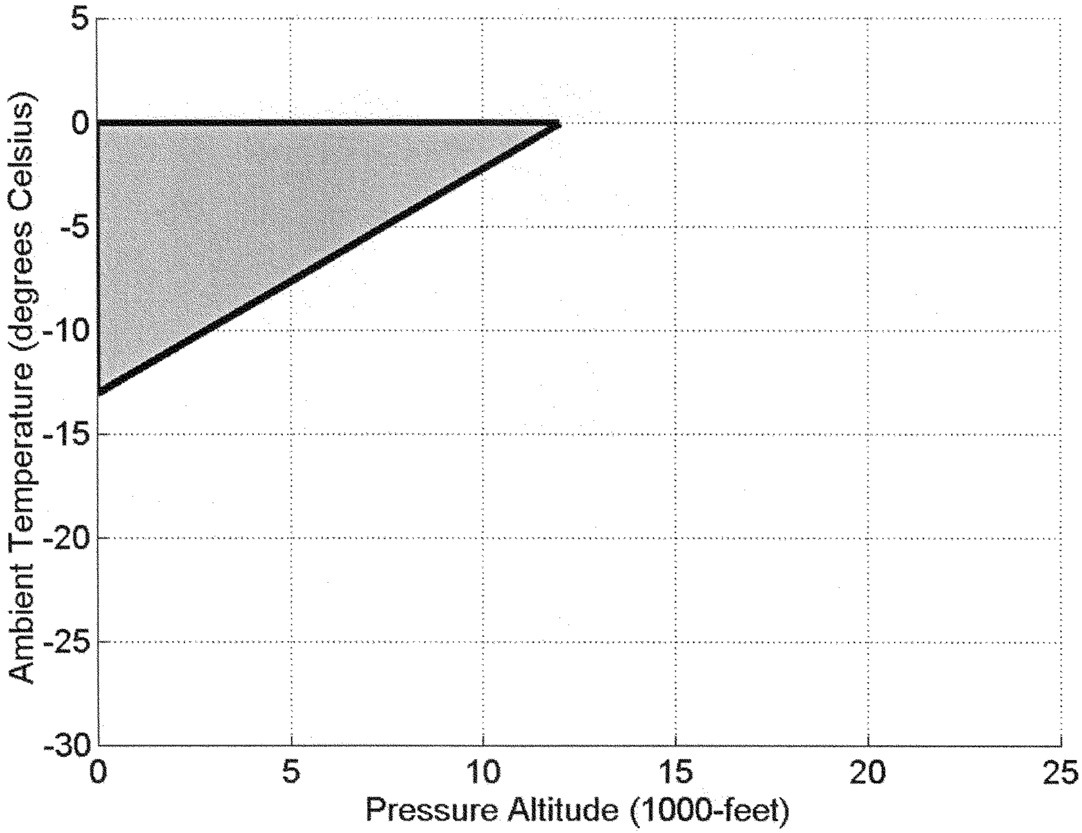
(5) Drop Diameter Distribution

FIGURE 5 - Appendix O, Freezing Rain, Drop Diameter Distribution



(6) Altitude and temperature envelope:

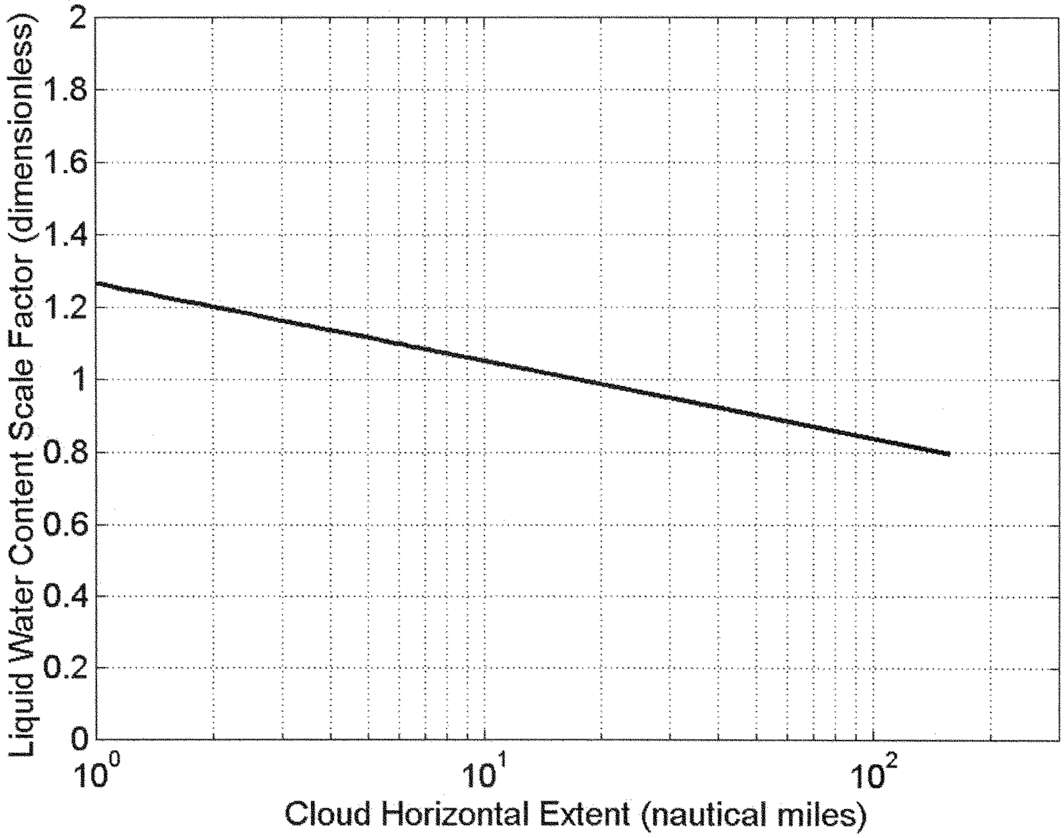
FIGURE 6 - Appendix O, Freezing Rain, Temperature and Altitude



(c) Horizontal extent.

The liquid water content for freezing drizzle and freezing rain conditions for horizontal extents other than the standard 17.4 nautical miles can be determined by the value of the liquid water content determined from Figure 1 or Figure 4, multiplied by the factor provided in Figure 7.

FIGURE 7 - Horizontal Extent, Freezing Drizzle and Freezing Rain



Part II—Airframe Ice Accretions for Showing Compliance With Subpart B

(a) *General.*

The most critical ice accretion in terms of airplane performance and handling qualities for each flight phase must be used to show compliance with the applicable airplane performance and handling qualities requirements for icing conditions contained in subpart B of this part. Applicants must demonstrate that the full range of atmospheric icing conditions specified in part I of this appendix have been considered, including drop diameter distributions, liquid water content, and temperature appropriate to the flight conditions (for example, configuration, speed, angle-of-attack, and altitude).

(1) For an airplane certified in accordance with § 25.1420(a)(1), the ice accretions for each flight phase are defined in part II, paragraph (b) of this appendix.

(2) For an airplane certified in accordance with § 25.1420(a)(2), the most critical ice accretion for each flight phase defined in part II, paragraphs (b) and (c) of this appendix, must be used. For the ice accretions defined in part II, paragraph (c) of this appendix, only the portion of part I of this appendix in which the airplane is capable of operating safely must be considered.

(3) For an airplane certified in accordance with § 25.1420(a)(3), the ice accretions for each flight phase are defined in part II, paragraph (c) of this appendix.

(b) Ice accretions for airplanes certified in accordance with § 25.1420(a)(1) or (a)(2).

(1) *En route ice* is the en route ice as defined by part II, paragraph (c)(3), of this appendix, for an airplane certified in accordance with § 25.1420(a)(2), or defined by part II, paragraph (a)(3), of appendix C of this part, for an airplane certified in accordance with § 25.1420(a)(1), plus:

(i) Pre-detection ice as defined by part II paragraph (b)(5) of this appendix; and

(ii) The ice accumulated during the transit of one cloud with a horizontal extent of 17.4 nautical miles in the most critical of the icing conditions defined in part I of this appendix and one cloud with a horizontal extent of 17.4 nautical miles in the continuous maximum icing conditions defined in appendix C of this part.

(2) *Holding ice* is the holding ice defined by part II, paragraph (c)(4), of this appendix, for an airplane certified in accordance with § 25.1420(a)(2), or defined by part II, paragraph (a)(4) of appendix C of this part, for an airplane certified in accordance with § 25.1420(a)(1), plus:

(i) Pre-detection ice as defined by part II, paragraph (b)(5) of this appendix; and

(ii) The ice accumulated during the transit of one cloud with a 17.4 nautical miles horizontal extent in the most critical of the icing conditions defined in part I of this appendix and one cloud with a horizontal extent of 17.4 nautical miles in the continuous maximum icing conditions defined in appendix C of this part. The total exposure to the icing conditions need not exceed 45 minutes.

(3) *Approach ice* is the more critical of the holding ice defined by part II, paragraph (b)(2) of this appendix, or the ice calculated in the applicable paragraph (b)(3)(i) or (ii) of part II of this appendix:

(i) For an airplane certified in accordance with § 25.1420(a)(2), the ice accumulated during descent from the maximum vertical extent of the icing conditions defined in part I of this appendix to 2,000 feet above the landing surface in the cruise configuration, plus transition to the approach configuration, plus:

(A) Pre-detection ice, as defined by part II, paragraph (b)(5) of this appendix; and

(B) The ice accumulated during the transit at 2,000 feet above the landing surface of one cloud with a horizontal extent of 17.4 nautical miles in the most critical of the icing conditions defined in part I of this appendix and one cloud with a horizontal extent of 17.4 nautical miles in the continuous maximum icing conditions defined in appendix C of this part.

(ii) For an airplane certified in accordance with § 25.1420(a)(1), the ice accumulated during descent from the maximum vertical extent of the maximum continuous icing conditions defined in part I of appendix C to 2,000 feet above the landing surface in the cruise configuration, plus transition to the approach configuration, plus:

(A) Pre-detection ice, as defined by part II, paragraph (b)(5) of this appendix; and

(B) The ice accumulated during the transit at 2,000 feet above the landing surface of one cloud with a horizontal extent of 17.4 nautical miles in the most critical of the icing conditions defined in part I of this appendix and one cloud with a horizontal extent of 17.4 nautical miles in the continuous maximum icing conditions defined in appendix C of this part.

(4) *Landing ice* is the more critical of the holding ice as defined by part II, paragraph (b)(2) of this appendix, or the ice calculated in the applicable paragraph (b)(4)(i) or (ii) of part II of this appendix:

(i) For an airplane certified in accordance with § 25.1420(a)(2), the ice accretion defined by part II, paragraph (c)(5)(i) of this appendix, plus a descent from 2,000 feet above the landing surface to a height of 200 feet above the landing surface with a transition to the landing configuration in the icing conditions defined in part I of this appendix, plus:

(A) Pre-detection ice, as defined in part II, paragraph (b)(5) of this appendix; and

(B) The ice accumulated during an exit maneuver, beginning with the minimum climb gradient required by § 25.119, from a height of 200 feet above the landing surface through one cloud with a horizontal extent of 17.4 nautical miles in the most critical of the icing conditions defined in part I of this appendix and one cloud with a horizontal extent of 17.4 nautical miles in the continuous maximum icing conditions defined in appendix C of this part.

(ii) For an airplane certified in accordance with § 25.1420(a)(1), the ice accumulated in the maximum continuous icing conditions defined in appendix C of this part, during a descent from the maximum vertical extent of the icing conditions defined in appendix C of this part, to 2,000 feet above the landing surface in the cruise configuration, plus transition to the approach configuration and flying for 15 minutes at 2,000 feet above the landing surface, plus a descent from 2,000 feet above the landing surface to a height of 200 feet above the landing surface with a transition to the landing configuration, plus:

(A) Pre-detection ice, as described by part II, paragraph (b)(5) of this appendix; and

(B) The ice accumulated during an exit maneuver, beginning with the minimum climb gradient required by § 25.119, from a height of 200 feet above the landing surface through one cloud with a horizontal extent of 17.4 nautical miles in the most critical of the icing conditions defined in part I of this appendix and one cloud with a horizontal extent of 17.4 nautical miles in the continuous maximum icing conditions defined in appendix C of this part.

(5) *Pre-detection ice* is the ice accretion before detection of appendix O conditions that require exiting per § 25.1420(a)(1) and (a)(2). It is the pre-existing ice accretion that may exist from operating in icing conditions in which the airplane is approved to operate prior to encountering the icing conditions requiring an exit, plus the ice accumulated during the time needed to detect the icing conditions, followed by two minutes of further ice accumulation to take into account the time for the flight crew to take action to exit the icing conditions, including coordination with air traffic control.

(i) For an airplane certified in accordance with § 25.1420(a)(1), the pre-existing ice accretion must be based on the icing conditions defined in appendix C of this part.

(ii) For an airplane certified in accordance with § 25.1420(a)(2), the pre-existing ice accretion must be based on the more critical of the icing conditions defined in appendix C of this part, or the icing conditions defined in part I of this appendix in which the airplane is capable of safely operating. The pre-detection ice accretion applies in showing compliance with §§ 25.143(k) and 25.207(k), and as part of the ice accretion definitions of part II, paragraph (b)(1) through (b)(4) of this appendix.

(c) *Ice accretions for airplanes certified in accordance with §§ 25.1420(a)(2) or 25.1420(a)(3).* For an airplane certified in accordance with § 25.1420(a)(2), only the portion of the icing conditions of part I of this appendix in which the airplane is capable of operating safely must be considered.

(1) *Takeoff ice* is the most critical ice accretion on unprotected surfaces, and any ice accretion on the protected surfaces appropriate to normal ice protection system operation, occurring between liftoff and 400 feet above the takeoff surface, assuming accretion starts at liftoff in the icing conditions defined in part I of this appendix.

(2) *Final takeoff ice* is the most critical ice accretion on unprotected surfaces, and any ice accretion on the protected surfaces appropriate to normal ice protection system operation, between 400 feet and either 1,500 feet above the takeoff surface, or the height at which the transition from the takeoff to the en route configuration is completed and V_{FTO} is reached, whichever is higher. Ice accretion is assumed to start at liftoff in the icing conditions defined in part I of this appendix.

(3) *En route ice* is the most critical ice accretion on the unprotected surfaces, and any ice accretion on the protected surfaces appropriate to normal ice protection system operation, during the en route flight phase in the icing conditions defined in part I of this appendix.

(4) *Holding ice* is the most critical ice accretion on the unprotected surfaces, and any ice accretion on the protected surfaces appropriate to normal ice protection system operation, resulting from 45 minutes of flight within a cloud with a 17.4 nautical miles horizontal extent in the icing conditions defined in part I of this appendix, during the holding phase of flight.

(5) *Approach ice* is the ice accretion on the unprotected surfaces, and any ice accretion on the protected surfaces appropriate to normal ice protection system operation, resulting from the more critical of the:

(i) Ice accumulated in the icing conditions defined in part I of this appendix during a descent from the maximum vertical extent of the icing conditions defined in part I of this appendix, to 2,000 feet above the landing surface in the cruise configuration, plus transition to the approach configuration and flying for 15 minutes at 2,000 feet above the landing surface; or

(ii) Holding ice as defined by part II, paragraph (c)(4) of this appendix.

(6) *Landing ice* is the ice accretion on the unprotected surfaces, and any ice accretion on the protected surfaces appropriate to normal ice protection system operation, resulting from the more critical of the:

(i) Ice accretion defined by part II, paragraph (c)(5)(i), of this appendix, plus ice accumulated in the icing conditions defined in part I of this appendix during a descent from 2,000 feet above the landing surface to a height of 200 feet above the landing surface with a transition to the landing configuration, followed by a go-around at the minimum climb gradient required by § 25.119, from a height of 200 feet above the landing surface to 2,000 feet above the landing surface, flying for 15 minutes at 2,000 feet above the landing surface in the approach configuration, and a descent to the landing surface (touchdown) in the landing configuration; or

(ii) Holding ice as defined by part II paragraph (c)(4) of this appendix.

(7) For both unprotected and protected parts, the ice accretion for the takeoff phase must be determined for the icing conditions defined in part I of this appendix, using the following assumptions:

(i) The airfoils, control surfaces, and, if applicable, propellers are free from frost, snow, or ice at the start of takeoff;

(ii) The ice accretion begins at liftoff;

(iii) The critical ratio of thrust/power-to-weight;

(iv) Failure of the critical engine occurs at V_{EF}; and

(v) Crew activation of the ice protection system is in accordance with a normal operating procedure provided in the Airplane Flight Manual, except that after beginning the takeoff roll, it must be assumed that the crew takes no action to activate the ice protection system until the airplane is at least 400 feet above the takeoff surface.

(d) The ice accretion before the ice protection system has been activated and is performing its intended function is the critical ice accretion formed on the unprotected and normally protected surfaces before activation and effective operation of the ice protection system in the icing conditions defined in part I of this appendix. This ice accretion only applies in showing compliance to §§ 25.143(j) and 25.207(h).

(e) In order to reduce the number of ice accretions to be considered when demonstrating compliance with the requirements of § 25.21(g), any of the ice accretions defined in this appendix may be used for any other flight phase if it is shown to be more critical than the specific ice accretion defined for that flight phase. Configuration differences and their effects on ice accretions must be taken into account.

(f) The ice accretion that has the most adverse effect on handling qualities may be used for airplane performance tests provided any difference in performance is conservatively taken into account.

PART 33—AIRWORTHINESS STANDARDS: AIRCRAFT ENGINES

24. The authority citation for part 33 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701, 44702, 44704.

25. Revise § 33.68 to read as follows:

§ 33.68 Induction system icing.

Each engine, with all icing protection systems operating, must:

(a) Operate throughout its flight power range, including the minimum descent idle rotor speeds achievable in flight, in the icing conditions defined in appendices C and O of part 25 of this chapter, and appendix D of this part 33, without the accumulation of ice on the engine components that:

(1) Adversely affects engine operation or that causes an unacceptable permanent loss of power or thrust or unacceptable increase in engine operating temperature; or

(2) Results in unacceptable temporary power loss or engine damage; or

(3) Causes a stall, surge, or flameout or loss of engine controllability (for example, rollback). The applicant must account for in-flight ram effects (for example; scoop factor amplification, water temperature, air density) in any critical point analysis or test demonstration of these flight conditions.

(b) Operate throughout its flight power range, including minimum descent idle rotor speeds achievable in flight, in the icing conditions defined in appendices C and O of part 25 of this chapter. In addition,

(1) It must be shown through Critical Point Analysis (CPA) that the complete ice envelope has been analyzed, and that the most critical points must be demonstrated by engine test, analysis or a combination of the two to operate acceptably. Extended flight in critical flight conditions such as hold, descent, approach, climb, and cruise, must be addressed, for the ice conditions defined in these appendices.

(2) It must be shown by engine test, analysis or a combination of the two that the engine can operate acceptably for the following durations:

(i) At engine powers that can sustain level flight: A duration that achieves repetitive, stabilized operation in the icing conditions defined in appendices C and O of part 25 of this chapter.

(ii) At engine power below that which can sustain level flight:

(A) Demonstration in altitude flight simulation test facility: A duration of 10 minutes consistent with a simulated flight descent of 10,000 ft (3 km) in altitude while operating in Continuous Maximum icing conditions defined in appendix C of part 25 of this chapter, plus 40 percent liquid water content margin, at the critical level of airspeed and air temperature, or

(B) Demonstration in ground test facility: A duration of 3 cycles of alternating icing exposure corresponding to the liquid water content levels and standard cloud lengths in Intermittent Maximum and Continuous Maximum icing conditions defined in appendix C of part 25 of this chapter, at the critical level of air temperature.

(c) In addition to complying with § 33.68(b), the following conditions shown in Table 1 of this section unless replaced by similar CPA test conditions that are more critical or produce an equivalent level of severity, must be demonstrated by an engine test:

TABLE 1—CONDITIONS THAT MUST BE DEMONSTRATED BY AN ENGINE TEST

Condition	Total air temperature	Supercooled water concentrations (minimum)	Median volume drop diameter (±3 microns)	Duration
1. Glaze ice conditions.	21 to 25 °F (−6 to −4 °C).	2 g/m³	25 microns	(a) 10 minutes for power below sustainable level flight (idle descent). (b) Must show repetitive, stabilized operation for higher powers (50%, 75%, 100% MC).
2. Rime ice conditions.	−10 to 0 °F (−23 to −18 °C).	1 g/m³	15 microns	(a) 10 minutes for power below sustainable level flight (idle descent). (b) Must show repetitive, stabilized operation for higher powers (50%, 75%, 100% MC).
3. Glaze ice holding conditions (Turboprop and turbofan, only).	Turbofan, only: 10 to 18 °F (−12 to −8 °C). Turboprop, only: 2 to 10 °F (−17 to −12 °C).	Alternating cycle: 0.3 g/m³ (6 minute) 1.7 g/m³ (1 minute).	20 microns	Must show repetitive, stabilized operation (or 45 minutes max).
4. Rime ice holding conditions (Turboprop and turbofan, only).	Turbofan, only: −10 to 0 °F (−23 to −18 °C) Turboprop, only: 2 to 10 °F (−17 to −12 °C).	0.25 g/m³	20 microns	Must show repetitive, stabilized operation (or 45 minutes max).

(d) The engine should be run at ground idle speed for a minimum of 30 minutes at each of the following icing conditions shown in Table 2 of this section with the available air bleed for icing protection at its critical condition, without adverse effect, followed by acceleration to takeoff power or thrust. During the idle operation the engine may be run up periodically to a moderate power or thrust setting in a manner acceptable to the Administrator. The applicant must document any demonstrated run ups and minimum ambient temperature capability during the conduct of icing testing in the engine operating manual as mandatory in icing conditions. The applicant must demonstrate, with consideration of expected airport elevations, the following:

TABLE 2—DEMONSTRATION METHODS FOR SPECIFIC ICING CONDITIONS

Condition	Total air temperature	Supercooled water concentrations (minimum)	Mean effective particle diameter	Demonstration
1. Rime ice condition	0 to 15 °F (−8 to −9 °C).	Liquid—0.3 g/m³	15–25 microns	By engine test.
2. Glaze ice condition	20 to 30 °F (−7 to −1 °C).	Liquid—0.3 g/m³	15–25 microns	By engine test.
3. Snow ice condition	26 to 32 °F (−3 to 0 °C)	Ice—0.9 g/m³	100 microns (minimum)	By test, analysis or combination of the two.
4. Large drop glaze ice condition.	15 to 30 °F (−9 to −1 °C).	Liquid—0.3 g/m³	100 microns (minimum); 3000 microns (maximum).	By test, analysis or combination of the two.

(e) The applicant must demonstrate by test, analysis, or combination of the two, acceptable operation in ice crystals and mixed phase icing conditions throughout part 33, appendix D, icing envelope throughout its flight power range, including minimum descent idling speeds.

26. Amend § 33.77 by adding paragraph (a) and by revising paragraphs (c) introductory text, (c)(1), (d), and (e)(1) through (4) to read as follows:

§ 33.77 Foreign object ingestion—ice.

(a) Compliance with the requirements of this paragraph shall be demonstrated by engine ice ingestion test or by validated analysis showing equivalence of other means for demonstrating soft body damage tolerance.

* * * * *

(c) Ingestion of ice under the conditions of this section may not —

(1) Cause an immediate or ultimate unacceptable sustained power or thrust loss; or

* * * * *

(d) For an engine that incorporates a protection device, compliance with this section need not be demonstrated with respect to ice formed forward of the protection device if it is shown that—

(1) Such ice is of a size that will not pass through the protective device;

(2) The protective device will withstand the impact of the ice; and

(3) The ice stopped by the protective device will not obstruct the flow of induction air into the engine with a resultant sustained reduction in power or thrust greater than those values defined by paragraph (c) of this section.

(e) * * *

(1) The minimum ice quantity and dimensions will be established by the engine size as defined in Table 1 of this section.

(2) The ingested ice dimensions are determined by linear interpolation between table values, and are based on the actual engine's inlet hilite area.

(3) The ingestion velocity will simulate ice from the inlet being sucked into the engine.

(4) Engine operation will be at the maximum cruise power or thrust unless lower power is more critical.

TABLE 1—MINIMUM ICE SLAB DIMENSIONS BASED ON ENGINE INLET SIZE

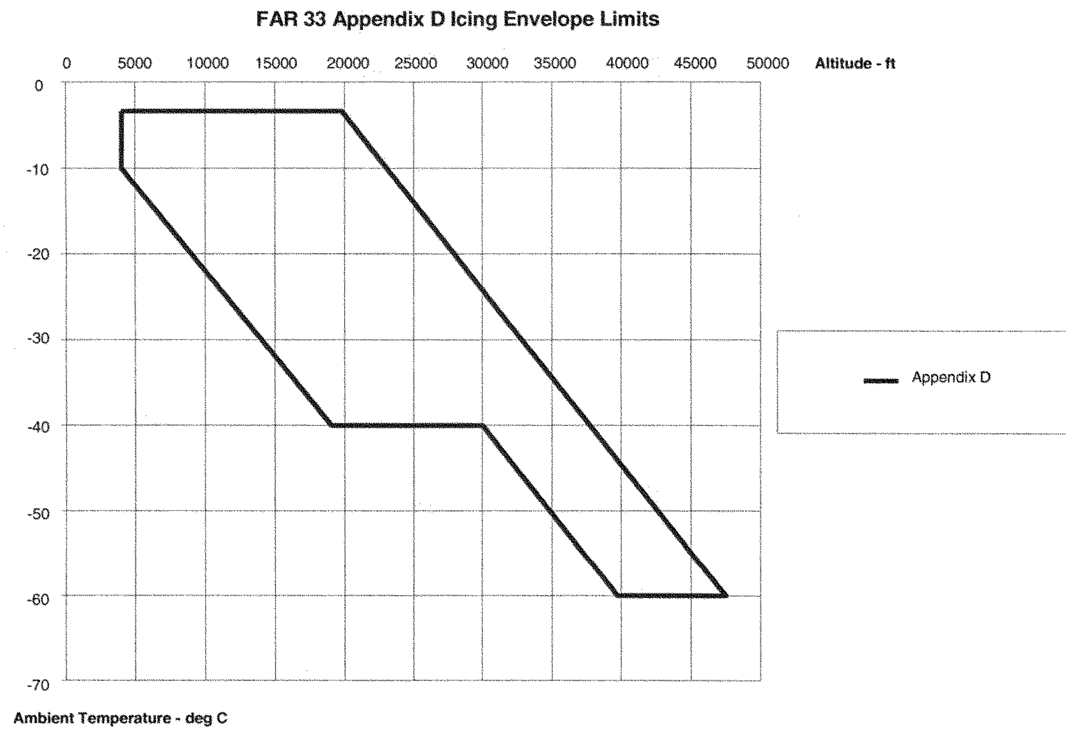
Engine inlet hilite area (sq inch)	Thickness (inch)	Width (inch)	Length (inch)
0	0.25	0	3.6
80	0.25	6	3.6
300	0.25	12	3.6
700	0.25	12	4.8
2800	0.35	12	8.5
5000	0.43	12	11.0
7000	0.50	12	12.7
7900	0.50	12	13.4
9500	0.50	12	14.6
11300	0.50	12	15.9
13300	0.50	12	17.1
16500	0.5	12	18.9
20000	0.5	12	20.0

27. Amend part 33 by adding appendix D to read as follows:

Appendix D to Part 33—Mixed Phase And Ice Crystal Icing Envelope (Deep Convective Clouds)

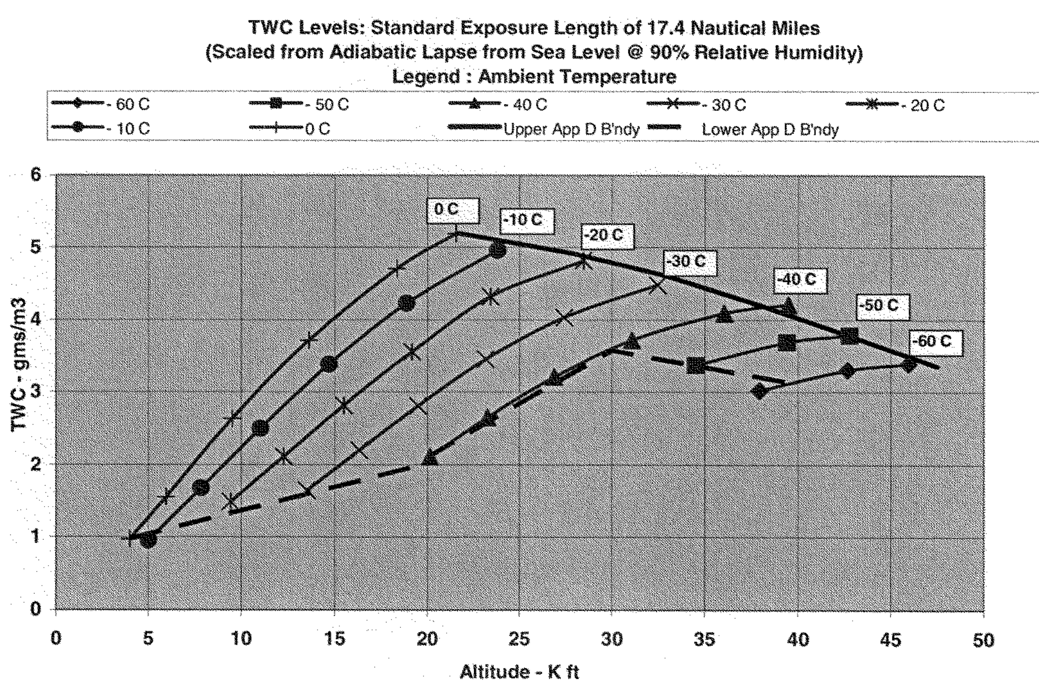
Ice crystal conditions associated with convective storm cloud formations exist within the part 25, appendix C, Intermittent Maximum Icing envelope (including the extension to −40 deg C) and the Mil Standard 210 Hot Day envelope. This ice crystal icing envelope is depicted in Figure D1, below.

Figure D1 - Convective Cloud Ice Crystal Envelope



Within the envelope, total water content (TWC) in g/m³ has been determined based upon the adiabatic lapse defined by the convective rise of 90% relative humidity air from sea level to higher altitudes and scaled by a factor of 0.65 to a standard cloud length of 17.4 nautical miles. Figure D2 displays TWC for this distance over a range of ambient temperature within the boundaries of the ice crystal envelope specified in Figure D1.

FIGURE D2 - Total Water Content



Ice crystal size median mass dimension (MMD) range is 50–200 microns (equivalent spherical size) based upon measurements near convective storm cores.

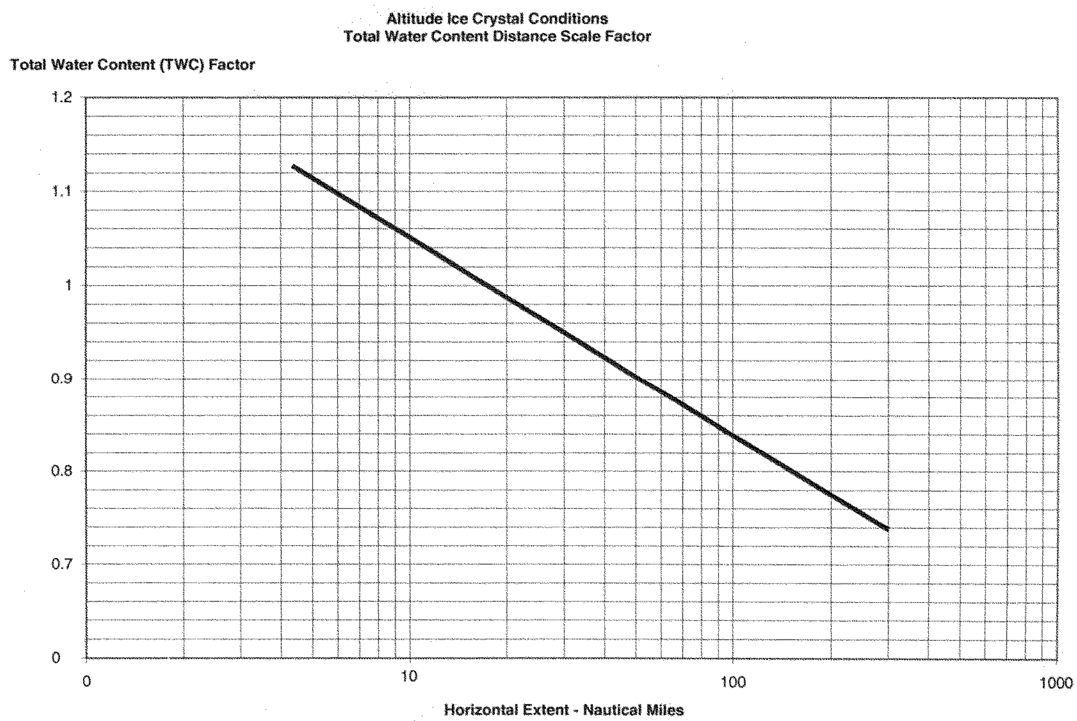
The TWC can be treated as completely glaciated (ice crystal) except as noted in the Table 1.

TABLE 1—SUPERCOOLED LIQUID PORTION OF TWC

Temperature range—deg C	Horizontal cloud length	LWC—g/m³
0 to −20	</= 50 miles	</=1.0
0 to −20	Indefinite	</=0.5
<−20		0

The TWC levels displayed in Figure D2 represent TWC values for a standard exposure distance (horizontal cloud length) of 17.4 nautical miles that must be adjusted with length of icing exposure. The assessment from data measurements in Reference 1 supports the reduction factor with exposure length shown in Figure D3.

FIGURE D3 Exposure Length Influence on TWC



Issued in Washington, DC, on June 23, 2010.

KC Yanamura,

Acting Director, Aircraft Certification Service.

[FR Doc. 2010–15726 Filed 6–28–10; 8:45 am]

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DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

14 CFR Part 39

[Docket No. FAA–2010–0640; Directorate Identifier 2009–NM–142–AD]

RIN 2120–AA64

Airworthiness Directives; EADS CASA (Type Certificate Previously Held by Construcciones Aeronauticas, S.A.) Model CN–235, CN–235–100, CN–235–200, and CN–235–300 Airplanes, and Model C–295 Airplanes

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Notice of Proposed Rulemaking (NPRM).

SUMMARY: We propose to adopt a new airworthiness directive (AD) for the products listed above that would supersede an existing AD. This proposed AD results from mandatory continuing airworthiness information (MCAI) originated by an aviation authority of another country to identify and correct an unsafe condition on an aviation product. The MCAI describes the unsafe condition as:

Prompted by [an] accident * * * the FAA published SFAR 88 (Special Federal Aviation Regulation 88) * * *.

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