U.S. Department
of Transportation
**Federal Aviation
Administration**

Transport Airplane Directorate
1601 Lind Avenue, S.W.
Renton, Washington 98057-3356

February 2, 2015

Exemption No. 11070A
Regulatory Docket No. FAA-2014-0299

Mr. Douglas M. Lane
Director, Regulatory Administration
The Boeing Company
P.O. Box 3707, MC 03-56
Seattle, WA 98124-2207

Dear Mr. Lane:

This letter is to inform you that we have granted your petition for an amendment to Exemption No. 11070. It explains the basis for our decision and describes its effect.

The Basis for Our Decision

By letter no. RA-15-00349, dated January 27, 2015, you petitioned the Federal Aviation Administration (FAA), on behalf of The Boeing Company, for an amendment to Exemption No. 11070. That exemption provides temporary relief from the requirements of § 25.1305(c)(5), Amendment 25-120, of Title 14, Code of Federal Regulations (14 CFR) to allow The Boeing Company to incorporate engine ice protection system changes without the powerplant ice protection system indication on Model 747-8 and 747-8F series airplanes powered by General Electric (GE) GEnx-2B engines. Boeing has thus far complied with the provisions of the original exemption. Your request to add a time-limited exemption from § 25.939(a), at Amendment 25-40, would allow changes to limitations in the airplane flight manual (AFM) of Model 747-8/-8F airplanes imposed by Airworthiness Directive (AD) 2013-24-01. The changes will allow partial relief from AD-mandated AFM limitations preventing flight into certain ice crystal icing (ICI) environments.

The GEnx-2B engines installed on Model 747-8/-8F airplanes have been shown to be susceptible to flameout and engine damage during operation in ICI conditions in service. Ingestion of ice crystals results in ice accretion in the engine. This ice accretion can release, resulting in engine damage and power interruption. GE and Boeing determined that periodically opening the variable bleed valve (VBV) doors in the engine compressor reduces the formation of ice. The latest GEnx-2B electronic engine control (EEC) software includes ICI logic designed to detect the presence of ICI conditions and cycles the VBV doors to reduce the risk of flameout and/or rollback. Boeing is proposing to revise the AFM

limitations associated with this interim solution to raise the current airplane operating restriction in ICI conditions from 30,000 feet to 35,500 feet with use of a flightcrew procedure to maintain adequate engine power levels. Boeing is showing that this ICI logic in the EEC software, in conjunction with the AFM limitations that this amendment would revise, will be effective in identifying ICI conditions and addressing the ICI threat. Boeing is requesting an amendment to the original time-limited exemption in order to introduce this interim design modification while Boeing implements an updated engine configuration that is compliant with § 25.939(a).

Section 25.939(a) at Amendment 25-40 requires that, for turbine-engine powered airplanes, "engine operating characteristics must be investigated in flight to determine that no adverse characteristics (such as stall, surge, or flameout) are present, to a hazardous degree, during normal and emergency operation within the range of operating limitations of the airplane and of the engine."

The operational procedure proposed to be included in the AFM limitation, would require maintaining minimum Mach numbers or airplane speeds at certain altitudes and airplane gross weights, to ensure that a minimum engine power setting is maintained to prevent ice accretion on internal engine components that could be mechanically damaging to compressor stages. The FAA has issued ADs to require in-flight crew procedures to restrict power settings to address identified unsafe conditions. However, the FAA does not accept in-flight crew procedures to restrict power settings as a method of complying with § 25.939(a). The purpose of this regulatory requirement is to assure engines will provide acceptable operating characteristics within the airplane operating envelope without undue burden on the flightcrew to manually control engine power settings.

The Boeing proposed AFM limitations and operating procedure for operating near or in ICI conditions require the flightcrew to maintain a minimum airplane speed, which maintains an adequate level of safety for the time period of this exemption. Although not compliant with § 25.939(a), Boeing states that this AFM limitation is consistent, from a flightcrew workload perspective, with other AFM limitations such as engine anti ice system, weight limitations, center of gravity limits, and ground operations in icing conditions. As part of the certification process, Boeing must demonstrate that this AFM limitation is acceptable from a flightcrew workload and complexity standpoint, and is operationally feasible. Boeing's petition states that they will extensively communicate the revised AFM limitation and associated operating procedure to the operators and their flightcrews via Flight Crew Operations Manual, Fleet Team Digest, Multi-Operator Message and other operator forums.

Although § 25.939(a) prescriptively requires that "operating characteristics must be investigated in flight," Boeing did not propose conducting flight tests in ICI conditions for certification of this AFM limitation change. Boeing proposed to use the results of the GE ground icing tests in combination with analysis to demonstrate the effectiveness of the EEC software change to sufficiently reduce ice accretion and mitigate the unacceptable operating characteristics below 35,500 feet. The FAA accepts Boeing's proposal as sufficient because this exemption is time limited in nature and part of an interim design change to address the ICI issue.

For the reasons cited in the original petition and repeated in the request for amendment, the FAA agrees with Boeing's statement of public interest.

Boeing requested the expiration date of December 31, 2015, for this amendment to the time-limited exemption and also requested expedited processing. Boeing explains that the additional time is needed based on the complexity of the design change and the showing of compliance. The FAA determined that Boeing has not substantiated the need for the additional time requested. Extending the deadline for the final design modifications would require more data and a thorough FAA review and would not support the timeline of Boeing's request for granting the amended exemption. Therefore we have established a June 30, 2015, compliance date for this time-limited exemption consistent with the similar Exemption No. 11081A granted for the Model 787-8/-9 airplanes.

As noted above, Boeing requested expedited processing of this exemption to meet customer needs. By granting relief from an additional regulation, this amendment supports an interim design change originally planned as part of a series of modifications to address ICI that was communicated to and accepted by the FAA. Furthermore, the FAA has previously approved similar AFM limitations on multiple occasions, including allowing relief from full compliance with 14 CFR 25.939(a), in order to mitigate unsafe conditions addressed through ADs. Full compliance must be demonstrated prior to removal of all associated limitations. Therefore, the FAA has determined that good cause exists for not publishing a summary of the petition, for public comment, in the *Federal Register* because the requested amendment to the exemption would not set a precedent, and any delay in acting on this petition would be detrimental to The Boeing Company and operators and flightcrews of 747-8/-8F airplanes.

Our Decision

The FAA has determined that the justification for the issuance of Exemption No. 11070 remains valid with respect to this amendment and is in the public interest.

The Effect of Our Decision

Our decision adds a time-limited exemption from § 25.939(a), at Amendment 25-40, to Exemption No. 11070 for Model 747-8 and 747-8F airplanes that have incorporated engine ice protection system modifications and associated AFM limitations. This grant of amended exemption provides a specific expiration date.

The Grant of Amended Exemption

In consideration of the foregoing, I find that a time-limited grant of exemption is in the public interest regarding 14 CFR 25.939(a) at Amendment 25-40. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, I grant The Boeing Company an exemption until June 30, 2015, from the requirements of § 25.939(a), as amended by Amendment 25-40. Specifically, this amendment approves substituting laboratory and ground tests for the requirement to investigate engine operating characteristics in flight and permitting use of airplane speed as a means to set minimum engine power needed to maintain engine operability in ice crystal icing environments. This amendment to the exemption is applicable to new production and in-service Boeing Model 747-8 and 747-8F airplanes incorporating modified EEC software with engine ice protection system changes and associated AFM limitations.

Boeing must show full compliance to 14 CFR 25.939(a), at Amendment 25-40, for newly produced Model 747-8 and 747-8F airplanes in order to receive a certificate of airworthiness after June 30, 2015. Design changes and modifications to in-service Model 747-8 and 747-8F airplanes involving engine ice protection systems and associated AFM limitations made after June 30, 2015, must also fully comply with 14 CFR 25.939(a) at Amendment 25-40.

All conditions and limitations of Exemption No. 11070 remain the same. This letter must be attached to, and is a part of, Exemption No. 11070.

Sincerely,

/s/

Jeffrey E. Duven
Manager, Transport Airplane Directorate
Aircraft Certification Service