

**UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98057-3356**

In the matter of the petition of

Hawker Beechcraft Corporation

for an exemption from § 25.981(a)(3),
Amendment 25-102, of Title 14, Code of
Federal Regulations

Regulatory Docket No. FAA-2006-25156

GRANT OF EXEMPTION

By letters of July 3, 2008, and August 13, 2008, Mr. David Bernstorf, Vice President, Airworthiness, Certification, and Technical Engineering, Hawker Beechcraft Corporation (HBC) (formerly Raytheon Aircraft Company), 9709 E. Central, P.O. Box 85, Wichita, Kansas, 67206, petitioned for an exemption from the requirements of Title 14, Code of Federal Regulations (CFR) 25.981(a)(3), as amended by Amendment 25-102, for their Model 4000 airplane. A prior partial grant of exemption, Exemption No. 8761, issued August 7, 2006, contained provisions that allowed airplanes to be delivered until September 1, 2008, without a complete showing of compliance with § 25.981(a)(3) and (b). The proposed exemption, if granted, would extend this relief for an additional six months. This extension allows HBC additional time to complete the necessary certification testing and documentation to show compliance with § 25.981(a)(3) and (b) for the fuel system components and with § 25.981(b) for the structural wing fasteners. It also allows HBC to complete their activities to support their request for a permanent exemption from § 25.981(a)(3) for the lightning protection of structural wing fasteners. As such, the proposed exemption, if granted, would also provide a permanent exemption from § 25.981(a)(3) for lightning protection of the structural wing fasteners, if certain conditions are met.

The petitioner requests relief from the following regulation:

§ 25.981(a)(3) Fuel tank ignition prevention, as amended by Amendment 25-102:

(a) No ignition source may be present at each point in the fuel tank or fuel tank system where catastrophic failure could occur due to ignition of fuel or vapors. This must be shown by:

(3) Demonstrating that an ignition source could not result from each single failure, from each single failure in combination with each latent failure condition not shown to be extremely remote, and from all combinations of failures not shown to be

extremely improbable. The effects of manufacturing variability, aging, wear, corrosion, and likely damage must be considered.

The petitioner supports its request with the following information:

The following information was submitted by HBC in their July 3, 2008, and August 13, 2008, letters. These letters, in addition to previously submitted petitions, are available for review at the Department of Transportation's Docket Operations, or on the Internet at <http://regulations.gov>. The docket number is FAA-2008-25156.

“Public Interest

“Full compliance to 25.981(a)(3), after September 1, 2008, with respect to lightning and the introduction of a third leg of protection for the Model 4000 will require significant redesign and modifications to the fuel tank, with no measurable improvements to aircraft safety. In addition to introducing additional complexity in the manufacturing, quality and maintenance procedures, a redesign of the proven technologies described above will add significant cost and schedule impact to the Model 4000 program and its customers.

“FAA requirements against the Model 4000 for with this rule will prevent HBC from certifying the aircraft on a timely and competitive schedule. This puts the Model 4000 at an unfair disadvantage with its competitors. Moreover, several of the major corporations around the US and the world [are] anticipating the delivery of the Hawker 4000 aircraft to meet their business needs would need to find alternatives.

“Effect on Safety

“The Model 4000 fuel tank system design is intended to fully comply with 14 CFR 25.981 as amended per amendment 102. Fuel tank ignition prevention is ensured through:

- low level of flammability exposure.
- prevention of ignition sources.

“The first item is substantiated by the design features on the Model 4000 fuel tanks that include a two tank system with separate left and right systems separated at BL0 by a center rib. The aircraft does not have a center wing tank. Both tanks are vented through two stringer vents that run the length of each tank. The vent lines are connected to a vent tank located at the outboard tip of each wing. The low flammability characteristics have been quantitatively assessed and documented to support compliance with FAA 14 CFR 25.981(c).

“The second item, prevention of ignition sources, has been substantiated by a thorough analysis of all ignition sources and the development of critical design

configuration control limitations to be submitted as part of the compliance shown for amendment 102.

“Regarding lightning aspects, the Model 4000 features two independent, effective, and reliable legs of protection:

- fasteners and rivets that inherently protect against arcing and hot spots under lightning strike conditions or a thin conductive layer over the fastener heads
- and the use of inner sealant.

“As a result of the design and construction of the wing panel attachments, there are no single failures of the fasteners that would result in ignition due to lightning strike.

“Consequently, taking into account all aspects of fuel tank flammability reduction for which the Model 4000 is compliant, and regarding the low flammability exposure as a mitigation factor for the absence of a third protection against lightning, Hawker Beechcraft Corporation believes granting this exemption has no impact on safety.

“Timing aspects of request

“Hawker Beechcraft Corporation (HBC) petitioned for and was granted a partial, time limited exemption #8761 to 14 CFR 25.981(a)(3), on August 7, 2006 for the Model 4000. The exemption expires on September 1, 2008 for new production aircraft. September 1, 2009 the exemption expires for completing the required Amendment 102 modifications to aircraft that have Certificates of Airworthiness dated prior to “September 1, 2008,

“Due to workload...additional time [is] needed to establish a viable design solution for wing fasteners in existing wing structure and new production.”

Therefore, as identified in the revised petition letter, dated August 13, 2008:

“1. HBC requests the FAA revise exemption 8761 to exempt HBC from full compliance with 14 CFR 25.981(a)(3) regarding the structural lightning protection of wing fasteners on the Model 4000.”

“Full compliance to the rule would require three (3) protective features with periodic inspection or a dual redundant design combined with either regular inspections at very short intervals or a monitoring device to verify the functionality of the protective features; both being impractical. In lieu of this, HBC will establish two independent and robust protective features for fuel tank structural fastener lightning protection... It should be noted that mitigation is provided by low fuel flammability exposure provided by unheated conventional aluminum wing tanks.

“2. Exemption 8761 initially was issued as a “Partial Grant of Exemption” containing a two year time limited exemption from 14 CFR 25.981(a)(3) and 25.981(b) as amended by Amendment 25-102 until September 1, 2008. For produced aircraft, the exemption also allowed an additional year for these aircraft to be modified by September 1, 2009 with any required design changes to meet 14 CFR 25.981 as amended by amendment 102.

“HBC is requesting the FAA revise Exemption 8761 to exempt HBC until March 1, 2009.

“HBC, prior to March 1, 2009, will complete the fuel system safety analysis and documentation to show compliance to 14 CFR 25.981(a)(3), 25.981(b) as amended by Amendment 25-102 and the exemption to 14CFR 25.981(a)(3) regarding the structural lightning protection of wing fasteners. In addition, HBC, prior to March 1, 2009, will submit service information to incorporate any design changes and/or operating and maintenance limitations developed to meet the provisions of 14 CFR 25.981(a)(3), 25.981(b), and exemption to 14 CFR 25.981(a)(3) regarding the structural lightning protection of wing fasteners.

“3. HBC requests the wording stated in the original exemption be revised to provide the following related to produced aircraft:

“Model 4000 airplanes produced prior to March 1, 2009, requiring design changes to fully meet the requirements of 14 CFR 25.981(a)(3) and 25.981(b) as amended by Amendment 25-102 and the exemption to 14CFR 25.981(a)(3) regarding the structural lightning protection of wing fasteners, are allowed to operate until March 1, 2010.

“For delivered airplanes, the above wording allows for concurrent implementation of systems and structural lightning design changes for HBC customers. Several of the major corporations around the US and the world anticipating delivery of the Model 4000 aircraft to meet their business needs would need to find alternative transportation during the multiple modifications (i.e. once for the wing structural aspect and once for the intrinsic safety aspect).”

Federal Register publication

A summary of HBC’s July 2, 2007, petition was published in the Federal Register on August 31, 2007 (72 FR 50430). One comment (from the Cessna Aircraft Company) was received, and will be discussed in the FAA’s analysis below.

The FAA’s analysis

The Cessna Aircraft Company expressed their concern about the energy levels exceeding the maximum amount allowed within the fuel tank under certain conditions for lightning or high-intensity radiated fields (HIRF) encounters. Cessna further

stated that compliance with the current guidelines regarding maximum allowable energy levels are difficult for lightning or HIRF induced effects.

Cessna's comments are related to the rule and its compliance methodology, rather than the provisions of this exemption. Therefore, addressing Cessna's concern is beyond the scope of this exemption.

The FAA has reviewed the information provided by HBC and has concluded that granting this exemption is in the public interest, for the reasons stated by the petitioner, and because we agree, pending the submission of the appropriate compliance data, that the proposed HBC 4000 design provides an acceptable level of safety.

The Hawker Beechcraft Corporation has now found it difficult and expensive to redesign the Model 4000 such that a complete finding of compliance to § 25.981(a)(3) can be made regarding the effects of lightning on certain structural wing fasteners.

The following FAA analysis pertains to the effects of lightning on structural wing fasteners.

Background:

In May 2001, the FAA issued Amendment 25-102, Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance & Inspection Requirements (Docket FAA-1999-6411, effective June 6, 2001). This amendment added specific ignition prevention requirements and a new flammability minimization requirement to § 25.981.

The amended ignition prevention requirements in § 25.981(a)(3) require consideration of factors such as aging, wear, and maintenance errors as well as the existence of single failures, combinations of failures, and latent failures that may be the cause of ignition sources in fuel tanks.

Section 25.981, as amended by Amendment 25-102, requires that airplane designs be protected from the effects of structural lightning with features that are failure tolerant. Prior to this amendment, only § 25.954 had been applied to lightning protection of fuel tanks. That provision requires only that the airplane design prevents ignition of vapors in the tank with no consideration of anticipated design failures, aging, and wear or maintenance errors.

Systems with potentially catastrophic failure modes would typically meet the requirements of § 25.981(a)(3), by providing at least triple redundancy in their protective features with periodic inspections, or dual-redundancy with continuous system monitoring to reduce the latency period. Dual redundant design schemes could only comply with § 25.981(a)(3) when combined with either regular inspections at very short intervals or a monitoring device to verify the functionality of

the protective features. Inspection of the various design features may be difficult or impossible if the feature is covered by airframe structure.

As it applies to fuel tank lightning protection for structural wing fasteners, the petitioner argues that both the addition of a third independent ignition source protective feature and providing sufficient monitoring to detect latent failures in a dual protective feature are impractical for certain areas of metallic airplane wing structure. We agree with the petitioner that compliance with paragraph (a)(3) would require a combination of redundant protective features and a high level of reliability of those features that are excessively expensive to produce and maintain using available technology. Lightning energy can be transferred to fuel tanks installed in wings through the many fasteners and other structural elements if there is a failure of protective features. It is impractical to provide either continuous monitoring of the “health” of the protective features for these structures, or to inspect them frequently enough to detect latent failures. These features are typically integral to the fuel tank structure or internal to the fuel tanks requiring access that may only be scheduled once or twice during the life of the airplane. However, metallic structural design schemes can generally be made capable of providing independent and robust dual redundancy in their protective features. By “robust” we mean features that, based on service experience, have been shown to provide high reliability between scheduled inspections.

As discussed in the preamble to Amendment 25-102, conventional unheated aluminum wing tanks minimize fuel tank flammability exposure, as required by § 25.981(c). Even if there were to be a latent failure of a protective feature for such a tank, the risk of lightning-induced fuel tank explosions is relatively low when fueled with low volatility fuels such as Jet A, as demonstrated by the service experience of these tanks. Because of the impracticality of full compliance with § 25.981(a)(3) for lightning protection and the reduced flammability exposure of these tanks, we believe exemptions may be in the public interest if applicants can show that their design provides dual protective features for fuel tank structural lightning protection that are both independent and robust.

Effect on Safety:

We concur that the Model 4000 fuel tanks exhibit low fuel vapor flammability characteristics. The Model 4000 does not have a true center wing fuel tank, which typically has high flammability characteristics. The air conditioning pack (air cycle machine) is located in the tail of the Model 4000, far from the wing fuel tanks and thus adds no heat into the fuel tanks. Furthermore, other than the wing leading edge anti-ice system, there are no heat sources within or near the fuel tanks.

The petitioner has demonstrated that fuel tanks on the Model 4000, which are unheated integral fuel tanks, meet the design guidelines identified in AC 25.981-2. The tanks are therefore considered to meet the regulatory intent of “minimizing the development of flammable vapors,” per § 25.981(c)(1).

HBC conducted a fuel tank flammability exposure analysis to determine the fuel flammability level during normal aircraft operation. The analysis was based on fuel temperature data acquired from fuel temperature survey certification testing. A review of fuel tank temperatures versus altitude was compared to maximum and minimum fuel flammability limits for Jet A through a normal long duration flight. Analysis of the test data showed the aircraft fuel temperatures overlap a portion of the flammability zone at higher altitudes. The only time fuel temperature readings were in the flammability zone was when the fuel level was relatively high, thus covering the in-tank electrical system components. When the tank fuel levels were low the fuel vapor temperature was cold enough to be outside of the flammability zone. We concur that the fuel vapor properties are such that these fuel tanks can be considered to have low flammability characteristics during operations. If design changes are necessary to achieve compliance with the requirements related to ignition prevention, HBC may be required to re-evaluate the impact of those changes on the flammability of the Model 4000 fuel tanks.

As described in more detail in HBC's petition, the two independent features of the HBC's structural wing fastener design that provide protection in the event of a lightning strike include either fasteners and rivets, that inherently protect against arcing and hot spots, or a thin conductive layer over the fastener heads, and an inner sealant. To substantiate the effectiveness of these lightning protection features of wing fasteners independently, lightning tests on sample wing panels are required. By "effective" we mean that the wing panel lightning tests would show that no arcing and/or sparking occurred on the inner side of the test panel. (See ARP 5416, "Aircraft Lightning Test Methods.")

The petitioner has conducted lightning tests on wing panels with degraded fastener installations to simulate conditions such as aging, wear, and maintenance errors. The "as installed" fastener design does provide redundant protection against arcing and hot spots due to lightning strikes. The lightning tests that were conducted to demonstrate that the machine-driven Briles rivet and collared fastener installations provide two robust design features that would prevent arcing within the fuel tank were partially successful. Tests of the hand-driven Briles rivet installation without backside sealant did show some arcing inside the tank. However, when Briles rivets are covered with a layer of brush-applied fuel tank sealant all ignition sources are prevented. HBC has proposed an additional protection feature that includes a thin sheet metal overlay for those hand-driven rivets that are subject to direct lightning attachment. If the lightning protection effectiveness of these features are adequately demonstrated, we believe that these features combined with a required sealant inspection program provide an adequate level of safety.

We agree with the petitioner that their proposed design provides an acceptable level of safety. However, while we do not agree with the petitioner's statement that "a third leg of protection . . . (provides) no improvements to aircraft safety," we acknowledge that full compliance with § 25.981(a)(3) would require significant

modifications to the fuel tank design, introduce additional complexity in the manufacturing and quality processes as well as maintenance procedures, and add significant cost and delivery schedule impact to the Model 4000 program. Without this exemption, HBC would not be permitted to obtain Certificate of Airworthiness for their aircraft. This would cause disruption to several major corporations in the US and the world that are anticipating the imminent delivery of the Model 4000 aircraft to meet their business needs. These HBC customers would need to find alternatives for their aviation needs. As explained above, we have allowed low fuel vapor flammability to play a larger role in the risk assessment of a design. The combination of low flammability exposure of the fuel tanks and the integrity of the redundant wing fastener design of the Model 4000 provides an acceptable level of safety with respect to detrimental effects of lightning.

Since HBC needs additional time to complete certification testing and documentation for the fuel system components and finalize their design solution for wing fasteners for both the production and retrofit applications, we find it is appropriate to extend certain provisions of Exemption No. 8761. Furthermore, HBC has delivered fewer production airplanes than expected under the original exemption issued on August 7, 2006. While this extension will allow continued delivery of airplanes until March 1, 2009, without a full showing of compliance to § 25.981(a)(3) and (b), the additional six month extension would not result in more airplanes being delivered than what was anticipated under the original exemption. Therefore, there is little additional safety risk in allowing continued airplane deliveries until March 1, 2009, with a required airplane modification date of March 1, 2010.

To ensure that HBC completes this activity in a timely manner, a condition of this exemption is that the FAA must approve the analysis, documentation, and design changes by the due date indicated, or the exemption expires and the Type Certificate becomes void. To facilitate HBC's actions to meet the conditions of this exemption, we will require HBC to provide a comprehensive certification plan and schedule to the FAA within 60 days of the granting of this exemption. Additionally, we will require that draft analysis and documentation in support of both the exemption and the design changes be submitted 60 days prior to the final analysis and documentation submittal. This will allow the FAA to identify any concerns with that data in advance and support HBC in meeting the conditions of the exemption.

Lastly, the current airworthiness limitation section for the airplanes delivered under the original exemption state that airplanes produced before September 1, 2008, cannot be operated after September 1, 2009, unless the necessary design changes and/or limitations are incorporated by the owner or operator. Our intent is to allow the airplanes delivered under the original exemption and this revised exemption to operate until March 1, 2010, by which time, the necessary design changes and/or limitations must be incorporated. This revised exemption contains language to allow the revision of the airworthiness limitation section for those airplanes delivered under the original exemption to contain the same limitations that are imposed on airplanes delivered under this exemption.

The FAA's decision

In consideration of the foregoing, I find that a grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. §§ 40113 and 44701, delegated to me by the Administrator, Exemption No. 8761 is amended to allow Hawker Beechcraft Corporation (HBC) to be exempt from the requirements of § 25.981(a)(3) as they pertain to the effects of lightning on structural wing fasteners for the Hawker Beechcraft Model 4000 with the following provisions:

1. HBC will complete the fuel system safety analysis and documentation to show compliance to § 25.981(a)(3) and § 25.981(b), as amended by Amendment 25-102, prior to March 1, 2009, for all fuel system components except compliance to § 25.981(a)(3) for structural wing fasteners.
2. Before March 1, 2009, HBC will develop and submit for FAA approval service information to incorporate any design changes and/or operating and maintenance limitations developed to meet the provisions of § 25.981(a)(3) and (b), as identified in condition 1 (above).
3. Before March 1, 2009, HBC will develop and submit for FAA approval, data and service information to incorporate any design changes and/or operating and maintenance limitations that have been shown to meet the following:
 - a. The structural wing fastener design includes two independent and effective layers of protection from the effects of lightning, and
 - b. The fuel tanks exhibit low fuel vapor flammability characteristics.
4. HBC must develop a comprehensive compliance plan and schedule, supporting the deliverables outlined in conditions 1, 2 and 3 (above), to be presented to the FAA within 60 days after the granting of this exemption. HBC must also submit drafts of the data and service information required by conditions 1, 2 and 3 (above) to the FAA by January 1, 2009.
5. The "Airworthiness Limitation" section of the Model 4000 "Instructions for Continued Airworthiness" will state that airplanes produced cannot be operated after March 1, 2010, unless the design changes submitted in accordance with conditions 2 and 3 (above) are incorporated by the owner or operator.
6. The "Airworthiness Limitation" section for those airplanes delivered under the original exemption, may be revised to reflect the limitations in condition 5 (above).

7. Unless the FAA approves the data and service information required by conditions 1, 2 and 3 (above), by July 1, 2009, this exemption expires and the HB 4000 Type Certificate becomes void.

Issued in Renton Washington, on August 28, 2008.

/s/

Dionne Palermo
Acting Manager, Transport Airplane Directorate
Aircraft Certification Service