Exemption No. 9148

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

In the matter of the petition of **Dassault Aviation** for an exemption from § 25.981(a)(3) at Amendment 25-102 of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2007-27562**

GRANT OF EXEMPTION

By letter dated March 8, 2007, Mr. Jean-Louis Chauvergne, Airworthiness Office, Dassault Aviation, 54, avenue Marcel Dassault, BP 24, 33701 Merignac Cedex, France, petitioned for an exemption from the fuel tank safety provisions of § 25.981(a)(3), as amended by Amendment 25-102, of Title 14, Code of Federal Regulations (14 CFR) as it relates to the structural lightning protection of wing fasteners. If granted, the exemption would permit type certification of Dassault Model Falcon 7X airplanes.

The petitioner requires relief from the following regulation(s):

Section 25.981(a)(3) 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:

(1) Determining the highest temperature allowing a safe margin below the lowest expected autoignition temperature of the fuel in the fuel tanks.

(2) Demonstrating that no temperature at each place inside each fuel tank where fuel ignition is possible will exceed the temperature determined under paragraph (a)(1) of this section. This must be verified under all probable operating, failure, and malfunction conditions of each component whose operation, failure, or malfunction could increase the temperature inside the tank.

(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:

"General

"Dassault Aviation requests an exemption from compliance with 14 CFR 25.981(a)(3) regarding the structural lightning protection of wing fasteners. The requirements include consideration of factors such as aging, wear, and maintenance errors, as well as the existence of latent failures in developing design that prevent ignition sources in fuel tanks.

"The area of interest for lightning strike on the wing tank is located in Zone 2. It is the inner part of the wing and is delimited by a 50 cm width band from fuselage/karman (1.4 m^2). This represents only 5 percent of the total wing fuel tank wetted area.

"All of the wing structure is made of metallic material (aluminum alloy) and is assembled in the zone of interest by titanium fasteners with corrosion resistant coating according to a state of the art design. The fasteners are internally protected by an overcoat made of 2 layers of wet sealant.

"Protection Design

"The first and major protective feature against arcing is the bonding between the fastener and the structure. Because of the interference fit nature of the fasteners located on the wing upper surface, a lightning attachment to an individual fastener will not cause any plasma spark products to be ejected into the fuel tank area.

"The bonding of the skin wing fasteners is performed by the contact between the fastener head and the countersunk hole in the upper skin, completed by the interference fit between the shank of the fastener and the skin panel hole for rivets and non-removable bolts.

"The quality and the repeatability of this bonding are ensured by the robotized manufacturing process. The nuts are of a type which has a locking feature and is designed not to come unscrewed in service. Thus, there is no possibility that fasteners when installed will not provide the correct clamping force.

"All the fasteners are made of titanium and coated with a protective material chosen for a high corrosion protection level and good conductive properties. This coating has been changed and improved compared to previous Falcon models. The strength against corrosion has been demonstrated by long duration salt atmosphere tests.

"The assembly process, the sealing and the protection against corrosion ensures no aging effect due to corrosion which could jeopardize fastener bonding.

"The second protective feature against in-tank arcing from lightning strike is provided by the sealant overcoat applied to each tank fastener in accordance with manufacturing process instructions. The presence of this sealant provides a layer of protection with regard to suppressing ejection of any spark products into the fuel tank area.

"In summary, the two layers of protection ensured by the tight fasteners and the sealant overcoat are robust and can be relied upon.

"Low Flammability Exposure

"The fuel system is pressurized by engine bleed that provides a regulated pressure above the ambient pressure. In addition, all the tanks are surrounded by cool air during flight. Because of that and the low temperature during flight, the tank flammability exposure is low.

"This low flammability has been quantitatively substantiated according to 14 CFR 25.981(c) and using a Monte Carlo analysis as described in Advisory Circular 25.981-2.

"Therefore, only fasteners located on the wing upper surface are to be considered as a potential ignition source, fasteners located on the wing lower surface being immersed during periods where flammability exposure is the highest.

"Public Interest

"A full compliance to § 25.981(a)(3) with respect to lightning and the introduction of a third leg of protection for the Model Falcon 7X would require significant modifications to the fuel tank design. Aside from introducing additional complexity in the manufacturing and quality process as well as maintenance procedures, a redesign of previously proven technology would add significant cost and schedule impact to the Falcon 7X program.

"Requiring the Falcon 7X to comply with this rule would prevent Dassault Aviation from certifying the aircraft on a timely and competitive schedule, putting it at an unfair disadvantage with its competitors. Moreover, several of the major corporations around the US and the world anticipating the delivery of the Model 7X aircraft to meet their business needs would need to find alternatives. Delaying delivery would impact aircraft manufacturing jobs, and airplane operations for many employees. Dassault's US and worldwide customers may need to find alternatives for their aviation needs.

"Effect on Safety

"The Falcon 7X fuel tank system design was intended to fully comply with 14 CFR 25.981 as amended by Amendment 25-102. Fuel tank ignition prevention is ensured through:

- low level of flammability exposure
- prevention of ignition sources

"The first item is substantiated qualitatively by the design features on the Falcon 7X fuel tanks that include pressurization, fuselage tank walls ventilation and internal fuel circulation and is quantitatively assessed through a Monte Carlo analysis as indicated in AC 25.98 1-2.

"The second item, prevention of ignition sources, is substantiated through a thorough analysis of all ignition sources and the development of critical design configuration control limitation.

"Regarding lightning aspects, the Falcon 7X tanks features 2 independent effective and reliable legs of protection: fasteners that inherently protects against arcing or hot spots under lightning strike conditions enhanced by the inner sealant overcoat. Because of the construction and the design of the wing panel attachments, there are no failure modes associated with the fasteners.

"Consequently taking into account all aspects of fuel tank flammability reduction for which the Falcon 7X is compliant, and regarding the low flammability exposure as a mitigation factor for the absence for three legs of protection against lightning, Dassault Aviation believes granting this exemption has no impact on safety."

Dassault's complete petition for exemption is available on the Department of Transportation's docket website. Go to http://dms.dot.gov. The docket number is FAA-2007-27562. The petitioner's complete supportive information is contained in its petition.

Notice and Public Procedure

A summary of this petition was published in the Federal Register, on March 26, 2007 (72 FR 14166). No public comments were received.

The FAA's analysis and summary of the petition is as follows:

Background:

In May 2001 the FAA issued the Transport Airplane Fuel Tank System Design Review, Flammability Reduction, and Maintenance & Inspection Requirements final rule (Docket

FAA-1999-6411, effective June 6, 2001) that was adopted as amendment 25-102. 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 basic airframe structure (airplane skins, joints, ribs, spars, stringers, and associated fasteners, brackets and coatings), 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 subsection (a)(3) would require a combination of redundant protective features and a high level of reliability of those features that is 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. 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.

Metallic structural design schemes can generally be made capable of providing independent and robust dual redundancy in their protective features. By "independent" we mean that the particular design feature as installed would prevent an ignition source

without the need for a secondary, back-up, or a redundant design feature. 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.

FAA's Analysis:

The FAA considers the petitioner's request to be in the public interest because the Falcon 7X design provides an acceptable level of safety and full compliance to § 25.981(a)(3) would require significant modifications to the fuel tank design, introduce additional complexity in the manufacturing and quality process as well as maintenance procedures, and add significant cost and schedule impact to the Falcon 7X program. The Falcon 7X type certification program is near completion with the expected certification date in late April 2007. Without this exemption, Dassault Aviation would not receive design approval for the aircraft in a timely manner, putting it at an unfair disadvantage with its competitors. This would cause disruption to several major corporations in the US and the world that are anticipating the imminent delivery of the Falcon 7X aircraft to meet their business needs. These Dassault customers may need to find alternatives for their aviation needs.

Dassault states in their petition that the results of their flammability analyses show that the fleet average flammability exposure of the fuel tanks is low and complies with § 25.981(c). The FAA has verified these analyses and agrees with Dassault's conclusion.

For the wing skin fasteners of the tanks in Zone 2, Dassault must demonstrate that at least two independent and effective means of lightning protection are provided and reliably maintained. Dassault considers the Falcon 7X design features of the fuel tanks sufficient to prevent in-tank arcing. The design uses two independent and effective layers of protection with (1) tight, interference fit fasteners bonding the skin panel to wing substructure, and (2) backside fastener sealant. Bonding of the wing fasteners is achieved by contact between the countersunk head and the upper skin, or through contact between the rivet shank and the side of the skin panel hole. A fully machined process, drilling wing panels on the wing substructure, typically has been used to achieve repeatability and quality of the assembly and the bonding. All fasteners are wet installed so the sealant creeps and completely fills any potential cavity and then a sealant covering is applied to all backside surfaces applicable to the type of fastener installation. Throughout the

manufacturing process, various inspection checks for drilling and sealant application are performed, and each structural tank is leak-checked with both air and fuel.

To substantiate the effectiveness of lightning protection features of wing fasteners independently, lightning tests on sample wing panels are required. As Dassault has been using these same construction principles of the wing skin panels on wing substructure for a long time and on many different airplane models, and since no mandatory requirements for testing panels existed prior to amendment 25-102, Dassault has no lightning test data for either loose fasteners or backside fastener sealant on the wing panel configurations.

As a condition associated with the granting of this exemption, Dassault has provided, and the FAA has approved, a lightning test program for at least two panel configurations, (1) wing panel with fasteners only (no sealant applied), and (2) wing panel with sealant but loose or degraded fastener fit. This test program can be completed post-certification, but no later than 4 months after issuance of the type certificate. Although the petitioner is confident in the outcome of the test, if the results do not demonstrate independent and effective lightning protection features for the fastener installations, this exemption will become void. 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.") We consider that airplanes placed into operation during this 4-month period present an acceptable risk because of their small number, the brief period of time, and the low flammability exposure of these fuel tanks.

Our approval of the Falcon 7X type certificate is conditioned upon Dassault's meeting the terms of this exemption. If these terms are not met within the prescribed 4-month period, the FAA would not issue further airworthiness certificates until these terms are met. The FAA would then work with Dassault to develop service instructions, if necessary, containing instructions for design changes, maintenance actions, and/or inspections, as appropriate, that we could mandate to provide an acceptable level of safety for previously delivered airplanes.

In addition to validating independent and effective design means of lightning protection for certification on new production airplanes, § 25.981(b) requires establishing critical design configuration control limitations (CDCCLs), inspections, and other procedures to prevent the development of ignition sources within the fuel tank system as the airplanes progress through their service life. These limitations, inspections, and procedures must be included in the Airworthiness Limitations Section of the Instructions for Continued Airworthiness required by § 25.1529.

Dassault has identified maintenance inspection tasks with appropriate inspection intervals to ensure the needed reliability of proper wing fastener installation and sealant coverage. These actions should maintain the lightning protection characteristics of these two independent protective features. The timely identification of fuel leaks, indicating a sealing defect(s), and subsequent timely repair to restore the integrity of the lightning protection feature is also important. Dassault has identified maintenance manual procedures that restore the protective features to the same level and with the same

products and techniques as the original design specifications. These procedures require aircraft downtime and fuel tank entry to perform. However, Dassault has also specified a procedure to temporarily restore the fastener seal using an external aluminum/sealant patch which not only stops the fuel leakage but restores the protective bonding means on the leaking hardware.

The FAA has considered the information provided by the petitioner and has determined that there is sufficient merit to warrant a grant of exemption. Note that the outcome of the conditions associated with the granting of this exemption may affect the regulatory compliance of the Falcon 7X if the results of the wing panel test program are not satisfactory.

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, Dassault Aviation is hereby granted an exemption from the requirements of 14 CFR § 25.981(a)(3) as it relates to fuel tank structural lightning protection of wing fasteners to the extent necessary to permit type certification of the Dassault Model Falcon 7X with the following conditions and limitations:

1. Regarding fuel tank structural lightning protection, in lieu of complying with the provisions of § 25.981(a)(3), Dassault must demonstrate at least two independent and effective lightning protection features of wing fasteners by performing lightning tests on sample wing panels. The wing panel lightning tests to validate the independence and effectiveness of lightning protection features may be performed post-certification, but must be completed no later than 4 months after issuance of the type certificate.

2. If Dassault is unable to demonstrate the independence and effectiveness of the fuel tank wing fasteners' lightning protection features within the prescribed period, the FAA will not issue further airworthiness certificates until Dassault shows that the conditions are met.

Issued in Renton, Washington, on April 20, 2007.

Ali Bahrami
Manager, Transport Airplane Directorate
Aircraft Certification Service