

**UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 980573356**

In the matter of the petition of

Raytheon Aircraft Company

for a two year time limited exemption from
§ 25.981, Amendment 25-102, of Title 14, Code
of Federal Regulations

**Regulatory Docket
No. FAA-2006-25156**

PARTIAL GRANT OF EXEMPTION

By letter of June 12, 2006, Mr. David Bernstorf, Director, Airworthiness and Certification, Raytheon Aircraft Company, 9709 E. Central, P.O. Box 85, Wichita, Kansas, 67201-0085, petitioned for a two year time limited exemption from the requirements of Title 14 Code of Federal Regulations (14 CFR) 25.981, Amendment 25-102. The proposed exemption, if granted, would allow completion of the type certification program by December 31, 2006, and allow the Raytheon Aircraft Company additional time to complete the remaining tests and compliance documentation necessary for FAA approval.

The petitioner requests relief from the following regulation:

§ 25.981, Fuel tank ignition prevention.

- (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 auto-ignition 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.

(b) Based on the evaluations required by this section, critical design configuration control limitations, inspections, or other procedures must be established, as necessary, to prevent development of ignition sources within the fuel tank system and must be included in the Airworthiness Limitations section of the Instructions for Continued Airworthiness required by Sec. 25.1529. Visible means to identify critical features of the design must be placed in areas of the airplane where maintenance actions, repairs, or alterations may be apt to violate the critical design configuration limitations (e.g., color-coding of wire to identify separation limitation).

(c) The fuel tank installation must include either—

(1) Means to minimize the development of flammable vapors in the fuel tanks (in the context of this rule, "minimize" means to incorporate practicable design methods to reduce the likelihood of flammable vapors); or

(2) Means to mitigate the effects of an ignition of fuel vapors within fuel tanks such that no damage caused by an ignition will prevent continued safe flight and landing.

The petitioner provides the following supportive information:

“Raytheon Aircraft Company is requesting a two year time limited exemption for compliance with Amendment 25-102 to 14 CFR 25.981. The Raytheon Aircraft Company Model 4000 type certification program is nearly complete, with TC issuance anticipated in the next 60 days. There is inadequate time available to conduct the fuel system safety assessment envisioned in the advisory circular material for this amendment, understand any potential design issues, and implement possible solutions. The two year exemption would allow adequate time for Raytheon Aircraft Company to contract with other industry resources that have experience complying with this requirement for assistance in developing a comprehensive Model 4000 compliance plan to this amendment. This plan would be provided to the FAA no later than 90 days following issuance of the TC.

“Raytheon Aircraft Company believes any additional safety benefit from full compliance to this amendment for their size aircraft would not be commensurate with the costs involved. This is especially true for the Model 4000 where the design and build activity is complete. Therefore, Raytheon Aircraft Company may pursue a permanent exemption for the Model 4000 in parallel to the compliance effort during the time limited exemption period.

“Public Interest:

“Granting this request for a time limited exemption is in the public interest. Raytheon Aircraft Company has concluded there is no adverse affect on safety based on the

current Model 4000 design features noted in other sections of this petition. Without the time limited exemption, a substantial delay will result in completing type certification and delivery of Model 4000 aircraft from the current plan. This delay would have significantly negative impact in several areas:

- Continued resource demands of both the FAA and FAA designees
- Reduction in employment of production workers at Raytheon Aircraft Company and its suppliers around the US and the world
- Several of the major corporations around the US and the world anticipating the delivery of the Model 4000 aircraft to meet their business needs would need to find alternatives
- The balance of trade between the US and other nations would be negatively impacted due to delayed deliveries and potential for lost sales
- Taxation at the local, state, and federal levels would be adversely impacted from loss of wage taxes and sales taxes

“Impact on Safety:

“Following the TWA 800 accident, the overall goal of the FAA was to prevent up to a four potential airline transport accidents over the next 50 years through promulgation of fuel system safety regulations. The Aviation Rulemaking Advisory Committee (ARAC) Fuel Tank Harmonization Working Group (FTHWG) reviewed accident data that showed the 3 fuel tank explosions since 1960 of unknown cause all involved center wing tanks on Boeing aircraft which had been heated by air conditioning packs. The data showed no spontaneous ignition events for wing tanks (i.e. those tanks contained in the wings outside of the fuselage). The preamble to amendment 102 states “The FTHWG concluded that the safety record of fuel tanks located in the wings was adequate and that if the same level could be achieved in center wing fuel tanks, the overall safety objective would be achieved.”

“The Model 4000 has no center wing tank, only integral aluminum wing fuel tanks. In addition, unlike Boeing and Airbus designs, 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.

“Raytheon Aircraft Company has also completed additional design and test activities for the Model 4000 beyond what are required for compliance with 14 CFR 25.981 at amendment 11 to further prevent fuel system ignition sources.

“Raytheon Aircraft Company believes granting this time limited exemption has no impact on safety. The Model 4000 fuel system is safe, exceeds the requirements of its current certification basis (14 CFR 25.981 at amendment 11), and meets the safety objective envisioned by the ARAC FTHWG for amendment 102 to 14 CFR 25.981 for this size of aircraft.”

“Additional Background Information:

“The tragic loss of TWA Flight 800 on July 17, 1996, lead the NTSB to issue recommendations to:

- Reduce heating of the fuel in center wing fuel tanks on the existing fleet of transport aircraft
- Reduce or eliminate operation with flammable vapors in the fuel tanks of new type certificated airplanes, and
- Re-evaluate the fuel system design and maintenance practices on the fleet of transport airplanes

“In January, 1998, the FAA tasked an Aviation Rulemaking Advisory Committee (ARAC) working group, the Fuel Tank Harmonization Working Group (FTHWG), to provide additional information prior to rulemaking. Key points from the ARAC study (Reference 2) include:

- The study focused on Boeing and Airbus airplanes
- The overall goal of the FAA was to prevent 4 potential airline transport accidents over the next 50 years
- There have been 17 worldwide airplane fuel tank explosions since 1960. Of these, two were caused by lightning strike, four were caused by engine fire, five were caused by static discharge during refueling, one was caused by a bomb, two occurred during ground maintenance, and three had unknown cause. The industry and FAA had already taken action to remedy the known causes.
- Common characteristics of the three accidents of unknown cause are:
 - They were all Center Wing Tanks (CWT) with air conditioning packs in close proximity
 - All explosions were on Boeing airplanes
 - All occurred on hot days
 - All had been delayed on the ground, and all had run their air conditioning packs for at least 30 minutes prior to the explosion.

There have been no spontaneous ignition events for wing tanks (i.e. those tanks contained in the wings outboard of the fuselage)

“The Reference 3 preamble to Amendment 102 further states:

“The FTHWG concluded that the safety record of fuel tanks located in the wings was adequate and that if the same level could be achieved in center wing fuel tanks, the overall safety objective would be achieved.”

“The FAA issued a Special Federal Aviation Regulation (SFAR) to provide a means for the FAA to establish clear expectations and standards, as well as a timeframe within which the design approval holders and public could be confident that fuel tank safety issues on affected airplanes were uniformly examined. In order to achieve the

benefits of this rulemaking for large transport airplanes, the FAA limited the applicability of the SFAR to airplanes with a maximum certificated passenger capacity of at least 30 or at least 7,500 pounds of payload. “Compliance is not required for smaller airplanes because it is not clear at this time that the possible benefits for those airplanes would be commensurate with the costs involved (Reference 3).”

“The objective of Amendment 102 to 14 CFR 25.981 is to prevent fuel tank system ignition sources and minimize the development of flammable vapors. While 14 CFR 25.981 has been updated through amendment 102 to address fuel tank safety for Part 25 certified airplanes (regardless of size), the equivalent requirements in Parts 23, 27, and 29 have not changed. Reference 3 states “service history has not indicated that immediate action is necessary to address the fuel tank systems of those types of aircraft at this time.”

“Raytheon Aircraft Company does not believe there is any additional safety benefit from full compliance to amendment 102 for this size of aircraft for the commensurate costs involved.”

“Model 4000 Design:

“Reference 3 [preamble to Amendment 25-102] states the rule is not intended to prevent the development of flammable vapors in fuel tanks. It does require practical means be incorporated into the airplane design if heat sources are placed in or near the fuel tanks that significantly increase the formation of flammable fuel vapors in the tank, such as air conditioning packs immediately below the fuel tank without provisions to reduce heat transfer from the packs to the tank. Reference 3 states “the intent of the rule is to require that fuel tanks are not heated, and cool at a rate equivalent to that of a wing tank in the transport airplane being evaluated.”

“The Model 4000 meets this intent of this rule change. The Model 4000 has no center wing tank, only integral aluminum wing fuel tanks outside of the fuselage. Unlike Boeing and Airbus designs, 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. Raytheon Aircraft Company believes this design meets the intent of amendment 102 to 14 CFR 25.981 to assure the fuel tanks are not heated and to minimize the development of flammable vapors in fuel tanks.

“Amendment 102 to 14 CFR 25.981 also focuses on preventing fuel system ignition sources. The Model 4000 has several design features to address this:

- The fuel pump installations were intentionally designed to eliminate any power wires in the fuel tank
 - fuel shut off valve is located on the aft spar with the wiring external to the fuel tanks
 - fuel pump wiring is external to the fuel tanks

- The fuel pumps are covered until at least low level annunciation
- Internal fuel pumps (AC backup pumps and DC start pump) have been subjected to the locked rotor test and passed
- The internal fuel pumps include thermal fuses and are explosion proof
- Wire harnesses inside of the tank are physically separated and have additional Teflon wrap added
- The fuel quantity indicating (FQIS) system on the Model 4000 consists of optical sensors, densitometers, and temperature probes in each tank with the signals routing to two fuel sensing cards in the avionics rack. Measures taken to prevent fuel ignition from the fuel quantity indication system include:
 - In-tank current limit to 0.010 amps for normal operation
 - In-tank current limit to 0.025 amps for single fault
 - Isolated fuel tank circuits from aircraft ground – floating circuit
 - Resistive current limiting circuits designed to be infallible as defined by IEC 79-11
 - Overbraid shielding of all tank circuit wiring to guard against EMI and lightning
 - For the case of a single power line fault in the interconnecting harness to 28VDC, current components located in the tank limited to 0.050 amperes with no other system faults present
 - The energy stored by any equipment located inside a fuel tank and its interfacing circuitry limited to 0.02 millijoules per tank under normal operating conditions and 0.04 millijoules under failure conditions
 - Lossy ferrite filters are used on the FQPM (Fuel Quantity Processing Module)
 - 360 degree shield termination at connectors.

“Other Considerations:

“14 CFR Part 21.93 guidance material allows a cost benefit analysis to be conducted when determining applicable regulations when making post TC type design changes. If amendment 102 to 25.981 was being considered as a post TC type design change, Raytheon Aircraft Company believes there would be no measurable increase in the safety level of the Model 4000 fuel system for the significant increase in cost. This shows that the FAA works together with industry to consider the cost and benefit of safety related changes.

“In addition, the FAA has set precedent within 14 CFR 25 for different levels of fuel system safety depending on the size of the airplane. 14 CFR 25.721 is one such example. This rule addresses spillage from the fuel system for landing gear failures and has additional requirements for airplanes with 10 seats or more.

“Even though amendment 102 to 14 CFR 25.981 applies to all Part 25 aircraft, it can be implied the major concern of the FAA was preventing catastrophic loss of large

airliner aircraft (i.e. Boeing and Airbus). This is evidenced by seeing that the SFAR only applied to aircraft with passenger capacity greater than 30, and that Parts 23, 27, and 29 have not been updated to reflect the new requirements of amendment 102.

“There has never been a spontaneous ignition event for wing tanks. There is no accident data to suggest the current level of safety of the fuel systems in the business aircraft class is not acceptable. The Raytheon Aircraft Company turbine fleet alone has accumulated over 50 million hours of operational service history with no accidents related to wing fuel tank spontaneous ignition. Service history was cited by the FAA as a reason to not apply the SFAR to Part 23 and 27 aircraft (Reference 3).

“Further, Raytheon Aircraft Company applied for the first extension of the Model 4000 type certification program on May 31, 2001. This was just prior to Amendment 102 to 14 CFR 25.981 becoming effective on June 6, 2001. The FAA always has the option to impose additional requirements against a type certification program if they feel a change in requirements is necessary because of safety concerns. No changes were made regarding fuel system safety, which implies the FAA considered the current Model 4000 certification basis (14 CFR 25.981 amendment 11) acceptable.

“Lastly, if the Model 4000 had completed type certification and received a TC by the end of May, 2006, the FAA would have been satisfied with the current fuel system design and its level of safety. Therefore, the current fuel system design of the Model 4000 provides an acceptable level of safety.

“Conclusion:

“The Model 4000 is near the completion of the type certification program, with design and build finished. It is not at the beginning of the design cycle where fuel system changes to fully comply with amendment 102 can be economically incorporated as discussed in Reference 3. While Raytheon Aircraft Company has gone beyond the current certification basis to meet the safety objective envisioned by the ARAC, and FTHWG, it is seeking a time limited exemption to allow adequate time to fully comply with amendment 102 without impacting the type certification and delivery schedule.

“The safety record for fuel system designs similar to the Model 4000 indicates the existing certification basis for the Model 4000 (14 C FR 25.981 at amendment 11) is adequate. The FAA has set precedent within Part 25 for different levels of fuel system safety depending on the size of the airplane (i.e. 14 CFR 25.721). The FAA has also set precedent within transport category aircraft for different levels of fuel system safety by only imposing amendment 102 requirements on Part 25 (airplanes) and not Part 29 (rotorcraft). Therefore, Raytheon Aircraft Company may pursue a parallel effort during the time limited exemption to seek a permanent exemption to amendment 102 for the Model 4000 as well as a rule change regarding the applicability of this requirement to this size of aircraft. Raytheon Aircraft Company does not believe there is additional safety benefit from full compliance to amendment

102 for this size of aircraft for the commensurate costs involved. Raytheon Aircraft Company will work with the FAA and industry to develop any proposed rule changes.”

On June 30, 2006, the FAA published a summary of the petition in the Federal Register (71 FR 37637) and requested comments on it from the public. No comments were submitted in response to the notice.

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

The FAA considers the petitioner’s request to be in the public interest because without this exemption there would be a significant disruption to air commerce; many operators are relying on the December 31, 2006, delivery date for these airplanes.

The regulatory standards of § 25.981, as amended by Amendment 25-102 require that-

1. 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.
2. Limitations, inspections, or other procedures must be established, as necessary, to prevent development of ignition sources within the fuel tank system and must be included in the airworthiness limitations section of the Instructions for Continued Airworthiness required by § 25.1529.
3. The fuel tank installation must include either means to minimize the development of flammable vapors in the fuel tanks or a means to mitigate the effects of an ignition of fuel vapors.

These requirements were adopted to address the need for protection of airplane fuel tanks from possible ignition sources and to minimize the flammability of fuel tank vapors. Though Raytheon states that it meets the safety objectives envisioned by the Aviation Rulemaking Advisory Committee (ARAC), Fuel Tank Harmonization Working Group, for Amendment 25-102 to 14 CFR 25.981 for this size of aircraft, these regulatory provisions do not differentiate requirements based on airplane size.

Raytheon Aircraft Company Model 4000 does not have a center wing fuel tank that is typically considered a high flammability tank. In addition, 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. The FAA notes that Raytheon’s design limits the energy stored by any equipment located inside a fuel tank and its interfacing circuitry to 0.02 millijoules per tank under normal operating conditions and 0.04 millijoules under failure conditions. Lossy ferrite filters are used on the Fuel Quantity Processing Module (FQPM) with 360 degree shield termination at connectors.

Raytheon Aircraft Company has also completed additional design and test activities for the Model 4000 in compliance with § 25.981 Amendment 25-11 to further prevent fuel system ignition sources inside the fuel tanks. Raytheon is confident based on their current design that there is no impact on the fuel system safety and states the fuel system design “exceeds the requirements of its current certification basis (§ 25.981 at Amendment 25-11)” The petitioner’s statement regarding this issue negates the need for relief from the provisions of § 25.981(a)(1) and (2), as amended by Amendment 25-102, which correspond to similar provisions specified in Amendment 25-11. The petitioner also states that “the Model 4000 has no center wing tank, only integral aluminum wing fuel tanks.” The wing tanks do not contain any heat sources that would increase the fuel vapor flammability and appear to be typical unheated wing tanks that would comply with the fuel vapor flammability provisions of § 25.981(c). Therefore, the petitioner does not need relief from the provisions of § 25.981(c).

Raytheon’s original application for type certification was August 1, 1996. Amendment 25-102 became effective on June 6, 2001, after Raytheon had substantially completed the basic design of Model 4000 aircraft. Even though Raytheon maintains that their fuel system design meets the provisions of § 25.981, as amended by Amendment 25-11, and their fuel system design must also meet the provisions of § 25.901(c) before the type certificate is issued, there are fuel tank ignition source issues that still need to be addressed under the provisions of § 25.981, as amended by Amendment 25-102. We consider it necessary in the interests of safety for Raytheon to comply with these applicable requirements. However, we recognize the unusual circumstances associated with these requirements becoming applicable only because of unanticipated delays in Raytheon’s certification program for the Model 4000. Under these circumstances, we consider Raytheon’s request for a two year delay in showing compliance for a limited number of components to be reasonable.

If it becomes necessary to modify the design to comply with these requirements, Raytheon intends to develop the necessary design changes and make them available to affected operators. There should be no adverse safety effects within the first two years of operation of the Model 4000 due to the lack of demonstrating compliance to the provisions of § 25.981. To ensure that these changes are incorporated on the airplanes, we are adopting a condition in this exemption that the “Airworthiness Limitation” section of the Raytheon 4000 “Instructions for Continued Airworthiness” will limit operation unless any design changes and/ or limitations developed are incorporated by the owner or operator. The FAA has carefully considered the information provided by the petitioner and has determined that there is sufficient merit to warrant a partial grant of a time-limited exemption.

Note that the conditions associated with the granting of this exemption may affect the production of new Model 4000 airplanes after September 1, 2008. If the type design is modified per the compliance requirements specified in the conditions of this

exemption, no new airworthiness certificates would be issued after September 1, 2008, unless the newly produced airplanes conform to the modified type design.

In consideration of the foregoing, I find that a partial grant of a time limited 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, Raytheon Aircraft Company is hereby granted an partial exemption until September 1, 2008, from the requirements of 14 CFR § 25.981 to the extent necessary to permit type certification of the Raytheon Model 4000 with the following provisions:

1. Raytheon will demonstrate and document compliance with 14 CFR 25.981(a) (1) and (2), and § 25.981(c), as amended by Amendment 25-102, prior to issuance of the Type Certificate.
2. Raytheon 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 September 1, 2008. As part of this action, Raytheon will develop a comprehensive compliance plan and schedule to be presented to the FAA within 90 days after issuance of the type certificate.
3. Before September 1, 2008, Raytheon 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 § 25.981(b), as amended by Amendment 25-102.
4. The “Airworthiness Limitation” section of the Raytheon 4000 “Instructions for Continued Airworthiness” will state that the airplanes produced before September 1, 2008, cannot be operated after September 1, 2009, unless any design changes and/ or limitations developed in accordance with paragraph 3 (above) are incorporated by the owner or operator.

Issued in Renton Washington, on August 7, 2006.

/s/

Ali Bahrami
Manager, Transport Airplane Directorate
Aircraft Certification Service