

**Exemption No. 8769**

**UNITED STATES OF AMERICA  
DEPARTMENT OF TRANSPORTATION  
FEDERAL AVIATION ADMINISTRATION  
RENTON, WASHINGTON 98055-4056**

In the matter of the petition of

**The Boeing Company**

Sections 25.855(b), 25.855(h)(2), 25.857(e)(2), 25.857(e)(3), 121.221(f)(1), 121.221(f)(2) and 121.221(f)(3) and 121.223 of Title 14, Code of Federal Regulations

**Regulatory Docket No. FAA-2005-21786  
and  
Regulatory Docket No. FAA 2005-22747**

**GRANT OF EXEMPTION**

By letter dated June 30, 2005 (BDCO-05-00692), Mr. D. B. Marcrauder, Lead Project Administrator, The Boeing Company, PO Box 3707, Mail Code 67-LR, Seattle, WA 98124-2207, petitioned for an exemption from the requirements of §§ 25.855(b), 25.855 (h)(2), 25.857(e)(2) and 25.857(e)(3) of Title 14, Code of Federal Regulations (14 CFR) for the main deck Class E cargo compartment of the 747-400 Large Cargo Freighter (LCF). The proposed exemption, if granted, would provide relief from the requirements to provide a complete cargo compartment liner, conduct flight tests to show compliance to smoke penetration requirements, provide a smoke detection system within the main deck cargo compartment, and provide a means to shut off the ventilating airflow to, or within, the main deck cargo compartment. This petition is in public docket FAA-2005-21786.

In a subsequent letter received October 13, 2005 (BDCO-05-01587), Mr. Marcrauder asked that the petition for exemption be expanded to include exemption from the operating requirements of §§ 121.221(f)(1), 121.221(f)(2), 121.221(f)(3) and 121.223 of Title 14, Code of Federal Regulations (14 CFR) for the main deck Class E cargo compartment of the 747-400 Large Cargo Freighter (LCF). Boeing submitted this petition on behalf of the potential operator(s). The proposed exemption, if granted, would provide relief from the requirements to provide a

ANM-05-430-E  
ANM-06-004-E

complete cargo compartment liner, provide a smoke detection system within the main deck cargo compartment, provide a means to shut off the ventilating airflow to, or within, the main deck cargo compartment and conduct flight tests to show compliance to smoke penetration requirements. This petition is in public docket FAA-2005-22747.

**The petitioner requests relief from the following regulations:**

**Sections 25.855(b) and 25.855(h)(2)** contain the material standards and design considerations for cargo compartment interiors. Section 25.855(b) states that a Class E cargo or baggage compartment, as defined in § 25.857, must have a liner, and the liner must be separate from (but may be attached to) the airplane structure. Section 25.855(h) requires flight tests to show compliance with the provisions of § 25.857 and § 25.855(h)(2) specifically addresses compliance with § 25.857 regarding entry of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers.

**Sections 25.857(e)(2) and 25.857(e)(3)** require a separate approved smoke or fire detector system to give warning at the pilot or flight engineer station located in each Class E cargo compartment; means to shut off the ventilating airflow to, or within, the compartment; and flight crew access to these controls in the crew compartment.

**Sections 121.221(f)(1), 121.221(f)(2), and 121.221(f)(3)** contain the material standards and design considerations for fire precautions in Class E cargo compartments. Section 121.221(f)(1) requires that the cargo compartment be completely lined with fire-resistant material. Section 121.221(f)(2) requires a separate system of an approved type smoke or fire detector to give warning at the pilot or flight engineer station. Section 121.221(f)(3) requires a means to shut off the ventilating airflow to, or within, the main deck cargo compartment and that the controls are accessible to the flight crew in the crew compartment. Section 121.223 requires flight tests to show compliance with the provisions of § 121.221, including entry of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers.

**The petitioner's supporting information is as follows:**

As required by 14 CFR 11.25, the petitioner has provided justification in support of its petition for exemption, as well as substantiation as to how the proposed type design would provide an acceptable level of safety and why granting the exemption would be in the public interest.

The petitioner states that its intent is to convert between three and five Boeing Model 747-400 passenger airplanes into Boeing Model 747-400 LCF airplanes. The primary purpose of these airplanes is carrying components that support Boeing Model 787 airplane production. While Boeing will own these airplanes, it is intended that the airplanes will be operated on behalf of Boeing by a part 121 operator and will be N-registered. The vast majority of the cargo will consist of large Model 787 airplane modules (i.e., wings and fuselage sections). The petitioner proposes that the Model 747-

400 LCF airplanes be allowed to carry other smaller Model 787 airplane parts that will be shipped with these large modules, and large/outsized cargo that directly supports Boeing corporate business activities but is not related to the Model 787. Traditional freighter airplanes cannot accommodate the large/outsized cargo. The Model 787 composite assemblies shipped in the LCF are generally non-flammable. Any flammable fluid present will be of limited quantity and must be sufficiently shielded from ignition sources.

The petitioner proposes that, as a condition for the requested exemptions, the Boeing Model 747-400 LCF airplanes transport only the cargo described above. Boeing states that these airplanes will not be used by Boeing or the airplane operator to conduct commercial freight hauling operations. The FAA interprets this to mean that neither Boeing nor the airplane operator will conduct commercial freight hauling operations of material other than noted above and approved per this exemption. In addition, the Model 747-400 LCF will have a special cargo handling system with rails that will not interface with air cargo industry standard pallets. The petitioner also states that these airplanes will not be sold to other operators.

The petitioner notes that the cargo compartment necessary to carry these large modules is more than twice the volume of the main deck cargo compartment on a Boeing Model 747-400 production freighter. Due to the design constraints necessary to carry large Model 787 airplane modules, the petitioner proposes that no fire protection systems be installed in the main deck cargo compartment. This requires an exemption from certain aspects of 14 CFR part 25, sections 25.855 and 25.857, and 14 CFR part 121, sections 121.221 and 121.223. Also, the petitioner states that the existing Boeing Model 747-400 lower lobe cargo compartments will be decommissioned as part of this modification; therefore, an exemption from the regulations applicable to cargo fire protection is only requested for the main deck cargo compartment.

The petitioner states the requirement for providing a complete liner is mitigated by:

(a) Installing partial liners that meet the requirements associated with Class E cargo compartments in order to provide impact protection to critical systems resulting from ground/cargo handling operations. These liners will be of a sufficient height (approximately 8 1/2 feet) to reduce the likelihood of debris building up behind the liners.

(b) Limiting the cargo to only approved Model 787 and other airplane components described above, and thereby assuring that there will not be a fire hazard in the main deck cargo compartment. The Model 787 composite assemblies that are being shipped in the Boeing Model 747-400 LCF airplane will not propagate a fire. Boeing has developed flammability related cargo acceptance criteria (Boeing Document D926UO13-44, "Flammability Acceptance Criteria for Cargo Carriage on the Boeing Model 747-400 LCF Airplane."). The petitioner states that this proprietary document will be submitted to the cognizant FAA Directorate for review and approval prior to operation and after any subsequent modifications. These flammability criteria also apply

to the tooling used to transport the allowable cargo. As a result, the tooling and cargo will not create an ignition source or create a fire hazard.

(c) Transporting the cargo in a safe way using certified shipping mechanical equipment (SME). Note that all shipments must be properly attached to certified SMEs. The SMEs are shipping tools unique to the Boeing Model 747-400 LCF airplane, and are designed and built to transport Model 787 major end items from the partners/suppliers to the pre-integration and final integration sites. Prior to shipment, the cargo must be packaged per packaging standards compliant with the flammability criteria in Document D926UO13-44. All shipments will require a flammability certificate issued by the shipper indicating acceptance to load.

In addition, the petitioner states that the mitigating factors identified above greatly minimize the risk of an airplane loss due to a cargo fire in comparison to a general commercial cargo airplane. The petitioner states that it considers an acceptable level of safety will be provided by the Boeing Model 747-400 LCF airplane through a combination of the design, means of transporting cargo, and strict control of cargo carried.

The petitioner notes that the design of the Boeing Model 747-400 LCF airplane includes a pressure bulkhead at STA 532. This separates the forward pressurized section of the airplane (which includes the flight deck) from the main deck cargo compartment, which remains virtually unpressurized (i.e., the environmental control system provides ventilation flow to maintain a temperature no lower than 40° F.) However, this flow does not maintain a constant pressure within the compartment, as in the flight deck; and during cruise, the cargo compartment pressure will be lower (i.e., higher altitude) than the pressure needed to provide sufficient oxygen for combustion. This design and the pressure differential between the pressurized and non-pressurized compartments will exclude the possibility of smoke, flames, or noxious gases penetrating into the flight crew compartment from the cargo compartment.

In addition, the petitioner states that a camera system will be installed in the unpressurized cargo compartment, which includes an electronic flight bag with camera viewing capability. The petitioner submits that to ensure that the camera system will not interfere with pilot workload, that it will be a non procedural and non essential system. Also, the petitioner submits, that the camera system will provide the flight crew a means of determining the status of the cargo compartment and will aid in Boeing Model 747-400 LCF cargo control criteria and cargo control loading processes.

Sections 25.855(h)(2) and 121.223 require flight tests to show compliance with the provisions of 14 CFR § 25.857 and § 121.221, respectively, regarding the entries of hazardous quantities of smoke or extinguishing agent into compartments occupied by the crew or passengers. The petitioner requests relief from § 25.855(h)(2) and § 121.223 due to the impracticality of conducting a cargo smoke penetration test in an extremely large unpressurized cargo compartment. The test is described in FAA Advisory Circular 25-9A, "Smoke Detection, Penetration, and Evacuation Tests and Related Flight

Manual Emergency Procedures.” The petitioner states, “... conducting a cargo smoke penetration test, as described in FAA Advisory Circular 25-9A, would not be feasible due to the limitations of existing test equipment and instrumentation used to conduct cargo smoke penetration tests.”

Note: The petitioner states that, because of the airplane configuration in combination with this exemption petition, it considers demonstrating compliance with §§ 25.855(h)(1), 25.855 (h)(3), and 121.223 is not applicable.

Sections 25.857(e)(2) and 121.221(f)(2) require an approved smoke or fire detector system that provides warning to the flight crew in the event of a cargo fire. The petitioner contends that due to the size of the main deck cargo compartment, the high ventilation rate, and the lack of cabin pressurization, compliance with current cargo fire/smoke detection requirements may not be possible with state-of-the-art detection systems available today. In order to comply with §§ 25.857(e)(2) and 121.221(f)(2), a new and novel fire detection technology would likely need to be developed, such as a multi-sensor type of detection system (e.g., gas sensor, thermal imaging, etc.). The development of such a system would not support the Boeing Model 747-400 LCF or Model 787 program schedules.

The petitioner states that the lack of a fire detection system is compensated for by the limitations described earlier on the cargo carried on the Boeing Model 747-400 LCF airplane. These limitations will ensure that any possible cargo fire that could occur would not represent a thermal threat to the airplane at any time.

The Model 787 end-item-assemblies and components and other outsized components will be subjected to flammability related cargo acceptance criteria. These criteria will require that all of the parts carried will be essentially inert, and there will not be any ignition sources or sufficient fuel within the cargo to sustain or propagate a cargo fire. This ensures that no cargo be allowed which could provide sufficient fuel for a sustainable cargo fire. Also, the petitioner states that these factors combine to provide an acceptable level of safety for the type of cargo carriage missions described above, and has requested relief and exemptions from §§ 25.857(e)(2) and 121.221(f)(2).

Sections 25.857(e)(3) and 121.221(f)(3) require a means to shut off the ventilating airflow to, or within, the cargo compartment, and that the controls for these means are accessible to the flight crew in the crew compartment. Conditioned pack air is required within the main deck cargo compartment to ensure that the Model 787 and other approved airplane components remain above a specific temperature. The ventilation system design also includes open vent holes located in the aft end of the airplane, which are needed for the outflow of air from the cargo compartment. However, as proposed, the flow of air resulting from the open vent holes will not be controlled. For this reason the complete control of ventilation air to and within the cargo compartment is not possible. Note that the flight crew will have the capability to turn off packs 2 and 3. These packs supply conditioned air to the main deck cargo compartment and can be turned off in the event the flight crew determines an emergency situation exists.

The petitioner states the cargo will be limited to that which will not create a fire hazard. This will provide an acceptable level of safety equivalent to that of an airplane designed to carry any allowable cargo. In addition, the petitioner believes that these standards and criteria eliminate the need for cargo compartment ventilation control. Therefore, the petitioner requests relief from the provisions of §§ 25.857(e)(3) and 121.221(f)(3).

The petitioner states that it is developing a Cargo Control Process to define the method of ensuring compliance to Boeing Document D926UO13-44. This will be a Boeing Process Instruction (BPI) document and will define the process for maintaining configuration control of the Model 787 shipping assemblies. The information will be provided to Model 787 suppliers shipping cargo on the Boeing Model 747-400LCF airplane. Each supplier will be required to adhere to the process.

The petitioner has requested that this exemption include allowance for the carriage of eight ship sets of Model 787 airplane components that will be used for the Model 787 certification flight and ground testing (ground test wiring will be installed on two ship sets of the Model 787 airplane components). These ship sets will have flight and ground test instrumentation wires, transducers, and signal-conditioning equipment (installed in the respective Model 787 airplane composite components) that are required for gathering flight and ground test data for the Model 787 airplane. It should be noted that a “ship set” is basically all the parts necessary to build one 787 airplane. Boeing advises that they will need eight 787 airplanes to conduct the certification tests.

**The petitioner’s statement of public interest follows:**

The public interest will be advanced by the grant of this petition since the use of air shipment of large airplane parts contributes to the competitive position of air transport manufacturers in the United States. Sales of transport airplanes contribute to the balance-of-trade, the gross domestic product and economic health of the United States. The level of safety is not compromised in comparison to similar existing large transport freighter airplane designs and the airplane will not carry passengers. In addition to creation of jobs and promotion of United States commerce, the large cargo freighter global logistical transportation system contributes to the competitiveness of Boeing airplanes in the global market through the use of lean manufacturing concepts on a global level. These are all in the public interest and the design proposed in combination with this petition maintains an acceptable level of safety.

**Notice and opportunity for public comment**

A summary of the petition for exemption from certain sections of part 25 was published in the *Federal Register* on July 20, 2005 (70 FR 41811). No comments were received.

A summary of the petition for exemption from certain sections of part 121 was published in the *Federal Register* on November 7, 2005 (70 FR 67528). One comment was received from a member of the general public. The commenter opposes the granting of this exemption but did not provide any substantiating information to support his opposition. While the FAA agrees with the commenter's desire that "... we want safe airplanes completely and thoroughly," we believe that the conditions noted in this exemption ensure an acceptable level of safety for this airplane.

**The FAA's analysis is as follows:**

For the reasons stated by the petitioner, the FAA agrees that the granting of this exemption is in the public interest. This exemption has the potential for reducing Boeing Model 787 operators' costs as well as costs associated with acquiring this airplane. This benefits the traveling public while also providing increased flexibility to the manufacturer.

The petitioner's design is for a limited number of very large, cargo freighter airplanes that will be used exclusively for carrying cargo to support the production of Boeing Model 787 airplanes (although components from other Boeing business products could also be carried provided they meet the ignition and flammability requirements). The petitioner has agreed to limitations restricting the types of cargo, packing material, and tooling that can be carried on these large cargo freighters. These flammability-related cargo acceptance criteria will be contained in Boeing Document D926UO13-44, "Flammability Acceptance Criteria for Cargo Carriage on the LCF." The petitioner has agreed that the flammability acceptance criteria "will be included in the appropriate Boeing Model 747-400 LCF and Boeing Model 787 design, process, operational, and cargo loading control documents." In addition, the FAA must approve all cargo listed in this document and any subsequent changes to this document.

The petitioner has correctly noted that, due to the large volume and ventilation flow rate in the compartment, conventional smoke detectors would likely not be sufficiently robust and sensitive to detect a fire within the parameters of current regulations (i.e., within 1 minute). The challenge of designing a smoke detector system to accomplish this task is, by itself, insufficient to justify the petition for exemption. However, when considered with (a) the limitations on cargo, (b) unpressurized cargo compartment, and (c) limited number of airplanes; the FAA acknowledges that the probability of a fire is very remote.

The cargo compartment pressure is not controlled. Ventilation is provided to maintain the compartment temperature above freezing. This feature causes the partial pressure of oxygen to be reduced as the airplane climbs to nominal cruise altitude. At nominal cruise altitude, the partial pressure of oxygen in the Class E cargo compartment will be below that which a fire can sustain itself. Sufficient restrictions placed on the type of cargo are designed to preclude other oxygen sources being available.

The petitioner and the FAA have exchanged proprietary correspondence on the design features, limitations on cargo approved for carriage and airplane performance, and

operational considerations. The FAA has reviewed the information and determined that the arguments provided by the petitioner are sufficient justification for granting this exemption.

The FAA also considered the petitioner's statements and the design and operational restrictions and concluded that our acceptance of the mitigating design and operational features is sufficient to provide an adequate level of safety considering the operational needs of the petitioner. The FAA's grant of the exemption should be based solely on the fact that the material being carried meets flammability criteria and restrictions on ignition and supplemental oxygen sources. Therefore, there is no need to extend the restrictions to one specific (i.e., Boeing Model 787) business product. The FAA grant of exemption permits Boeing Model 747-400 LCF to carriage of all material that supports Boeing's corporate business line and meets the flammability related cargo acceptance criteria contained in FAA-approved Boeing Document D926UO13-44. Boeing's petition included a description that "... any parts (including packing materials) which fail to meet the flammability criteria in Boeing Document D926UO13-44 will be suitably isolated and enclosed or a "Safe Method of Transport" will be demonstrated, per the requirements of Document D926UO13-44." However, as D926UO13-44 provides the acceptance criteria, FAA interprets this to mean that any parts (including packing materials) which fail to meet the flammability criteria in Boeing Document D926UO13-44 will be suitably isolated, enclosed **and** a "Safe Method of Transport" will be demonstrated, per the requirements of Document D926UO13-44. This will be reflected in the conditions granting this exemption. Furthermore, each such item and its method of carriage will be reviewed and approved by the cognizant aircraft certification office prior to implementation for use on the Boeing Model 747-400 LCF airplane.

Boeing states that this Boeing proprietary document will be submitted to the cognizant aircraft certification office for review and approval prior to operation of this airplane and after any subsequent modifications to the document. The flammability criteria in the document also apply to the tooling used to transport the allowable cargo. As a result, the tooling and cargo will not create an ignition source or create a fire hazard.

As noted, the Boeing Model 747-400 LCF airplane will have a cargo camera system composed of multiple cameras. The cargo camera system will provide the electronic flight bag with the ability to view the contents in the cargo compartment from either side as well as from the front or back. The design includes multiple LED lights that provide illumination of the cargo compartment for the cameras. While the illumination and resolution is such that the cargo cameras can discern the outline (silhouette) of the cargo or a person in the compartment; in terms of fire detection capability, the resolution would probably not be sufficient to discern a small quantity of smoke from a smoldering fire. However, should a smoldering fire transition to a flaming fire, then the additional illumination would likely result in the cargo cameras detecting the flames. While this feature provides some additional information pertinent to the flight crew, the FAA did not consider the presence of this system to be significant in granting the exemption to the applicable part 25 regulations due to the lack of resolution to detect a smoldering fire and lack of annunciation to the crew if a fire is present. However, in consideration of the

impact that this design feature has in regards to the applicable part 121 regulations, the presence of the multiple cameras will provide the pilots with a viewing capability and will provide a means of determining if a large fire is present. This was considered significant from an operational/piloting perspective in granting the exemption to applicable part 121 regulations.

The Boeing Model 747-400 LCF Type Certificate Data Sheet (TCDS) will state that these airplanes are only approved for the transport of the cargo described in the Boeing Model 747-400 LCF Airplane Flight Manual (AFM) and the TCDS will state that these airplanes are not approved for commercial freight hauling operations of material other than that approved per this exemption. The LCF AFM must include a limitation for cargo carriage in the Certificate Limitations section, and will identify the FAA-approved 747-400 LCF Weight and Balance Manual (WBM) for the list of allowable cargo. In addition, the LCF AFM and TCDS will include a limitation that the Boeing Model 747-400 LCF lower lobe cargo compartments are decommissioned preventing any cargo to be carried in the lower lobe cargo compartments. The WBM will refer to the "Allowable Cargo" document that will identify the subassemblies acceptable for shipment, and the acceptable shipment configurations. The WBM will also list the allowed SME configurations, and require that each assembly being shipped come with a "Flammability Conformance Certificate" signed by the manufacturer/assembler's designated representative. The LCF Loadmaster can verify the SME is listed in the WBM, and verify that the manufacturer has provided a signed "Flammability Conformance Certificate" with the composite assembly.

### **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, the petitions of the Boeing Company, for an exemption from the requirements of 14 CFR 25.855(b), 25.855 (h)(2), 25.857(e)(2), 25.857(e)(3), and from the requirements of 14 CFR 121.221(f)(1), 121.221(f) (2), 121.221(f)(3) and 121.223, on the behalf of the operator(s), to the extent necessary to exclude the need for a complete cargo compartment liner, conduct flight tests to show compliance to smoke penetration requirements, provide a smoke detection system within the main deck cargo compartment, and provide a means to shut off the ventilating airflow to, or within, the main deck cargo compartment. This grant of exemption permits Boeing Model 747-400 LCF to carriage of all material that supports Boeing's corporate business line and meets the flammability related cargo acceptance criteria contained in FAA-approved Boeing Document D926UO13-44.

This exemption is subject to the following conditions:

1. The Boeing Model 747-400 LCF AFM must include a limitation for cargo carriage in the Certificate Limitations section, and identify the FAA-approved Boeing Model 747-400 LCF WBM for the list of allowable cargo. The WBM will refer to the

“Allowable Cargo” document that will identify the subassemblies acceptable for shipment, and the acceptable shipment configurations.

2. The Boeing Model 747-400 LCF AFM must include a limitation for cargo carriage in the Certificate Limitations section which states that the cargo compartment camera viewing system must be operational to enable cargo to be carried.

3. Any modifications to the Boeing flammability related cargo acceptance criteria (i.e., Boeing Document D926UO13-44) must be submitted to the cognizant aircraft certification office for review and approval prior to implementation for use on the Boeing Model 747-400 LCF airplane and after any modifications to the cargo acceptance criteria. Boeing must create a process for approval of revisions/modifications to this document and have this process in place prior to delivery of the first Boeing Model 747-400 LCF airplane.

4. Prior to operational flights, Boeing must have a Cargo Control Process which defines the method of ensuring compliance to Boeing Document D926UO 13-44. This Boeing Process Instruction document will define the process for maintaining configuration control of the Model 787 and other Boeing corporate business shipping assemblies. The information must be provided to Model 787 suppliers and other Boeing corporate business suppliers shipping cargo on the Model 747-400 LCF prior to operational flights. Each supplier will be required to adhere to the process.

5. Any parts (including packing materials) which fail to meet the flammability criteria in Boeing Document D926UO13-44 will be suitably isolated, enclosed, and a "Safe Method of Transport" will be demonstrated per the requirements of Boeing Document D926UO13-44. Each such item and its method of carriage will be reviewed and approved by the cognizant aircraft certification office prior to implementation for use on the Boeing Model 747-400 LCF airplane.

Issued in Renton, Washington, on August 18, 2006.

Signed by Kalene C. Yanamura  
Kalene C. Yanamura  
Acting Manager  
Transport Airplane Directorate  
Aircraft Certification Service