

Exemption No. 7478

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

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In the matter of the petition of *

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The Boeing Company * Regulatory Docket
* No. FAA-2000-8492

for an exemption from Section *
25.1435(b)(1) of Title 14 *
Code of Federal Regulations *

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PARTIAL GRANT OF EXEMPTION

By letter of October 31, 2000, Mr. Norman I. Lee, III, Manager, Certification Programs, B-H320, The Boeing Company, P.O. Box 3707, Seattle, WA, 98124-2207, petitioned for a partial exemption from the static pressure test requirement of Section 25.1435(b)(1) of Title 14, Code of Federal Regulations (14 CFR).

The proposed exemption, if granted, would permit amended type certification compliance for the hydraulic systems on the Boeing Model 777-200LR and 777-300ER series airplanes by (1) similarity to the previously tested hydraulic system on the Boeing Model 777-200 for the unchanged parts of the installations, and (2) conducting proof pressure test at the pressure relief valve setting (3400 psig) in lieu of the 1.5 times design operating pressure (4500 psig) for the changed parts of the installations.

The petitioner requests relief from the following regulation:

Section 25.1435(b)(1) states that a complete hydraulic system must be static tested to show that it can withstand 1.5 times the design operating pressure without a deformation of any part of the system that would prevent it from performing its intended function. Clearance between structural members and hydraulic system elements must be adequate, and there must be no permanent detrimental deformation. For the purpose of this test, the pressure relief valve may be made inoperable to permit application of the required pressure.

ANM-00-082-E

The petitioner's supportive information is as follows:

"Boeing proposes the following to certify the 777-200LR and 777-300ER to FAR 25.1435(b)(1)."

"Proof pressure test of hydraulic tube changes as explained below.

"Unchanged hydraulic equipment installations by similarity to the 777-200, 777-200IGW, and/or 777-300, where appropriate.

"Where tubing changes are common to the 777-200LR and 777-300ER, conduct the proof pressure test on the 777-300ER and certify the identical tube routings on the 777-200LR by similarity to the 777-300ER.

"Boeing requests a partial exemption from provisions of Federal Aviation Regulation (FAR) 25.1435(b)(1) for the hydraulic systems to be installed in new aircraft model derivatives 777-200LR and 777-300ER (777-200LR/-300ER)."

"The Design Operating Pressure (DOP) of the three hydraulic systems on the 777 model aircraft is 3,000 psig (20,680 kPa); to comply with FAR 25.1435(b)(1) would require a static hydraulic system pressure test of 4,500 psig (31,030 kPa). Boeing proposes, in lieu of a 4,500 psig static hydraulic system pressure test (aka proof pressure test), to demonstrate compliance with FAR 25.1435(b)(1) on the 777-200LR/-300ER by conducting a 3,400 psig (23,440 kPa) functional test only on the tube routing that has been changed relative to the 777-200 and 777-300 (777-200/-300).

The proposed test would be conducted at just below the system relief pressure of 3,400 psig and, where appropriate, equipment will be moved through their full range of motion to demonstrate adequate clearance exists between hydraulic components and surrounding systems.

"Except for the following minor changes, the hydraulic power and distribution system of the 777-200LR/-300ER is identical to that of the 777-200/-300, both models comply with FAR 25.1435(b)(1):

"Rerouting of tubes in outer wing to the Aileron Power Control Units (PCUs).

"Rerouting of hydraulic system tubes in the aft cargo hold (section 46) caused by addition of auxiliary fuel tanks.

"Minor tube routing changes to accommodate structural gage changes.

"Rerouting of hydraulic tubes on the Main Landing Gear.

"Hydraulic line size increases in the empennage."

"Public Interest Statement Summary in Accordance with FAR 11.25(d)."

"Granting of this exemption is in the public interest because Boeing's proposed method of demonstrating compliance will enhance the current level of safety by identifying additional dynamic interference problems. The applicant presents the following factors which substantiate that this Petition for Exemption provides an equal or greater level of safety as well as eliminating inefficiencies and added cost.

"1) Purpose of FAR 25.1435(b)(1) Pressure Test - The purpose of the test is to check a complete hydraulic system and show adequate separation between the hydraulic system elements and adjacent elements, including structure, such that there will be no permanent detrimental deformation that would prevent the hydraulic system from performing its intended function. If the test were to be performed at 4,500 psig (31,030 kPa), many components would have to be disconnected or blocked off from the 4,500 psig pressure source to prevent pressure relief to return or structural overload. The deactivation of many components would render the hydraulic system out of configuration. Also, if the test were to be performed at 4,500 psig, it would be a static test whereas a test conducted at 3,400 psig (23,440 kPa) would permit verification of hydraulic system element separation during normal actuation.

"The FAR also verifies clearance between hydraulic lines, tubes, structure, electrical wiring, Environmental Control System ducts and other systems. Allowing the test to be

conducted at 3,400 psig permits the operation of flight control surfaces and other systems to verify the clearances around the hydraulic tubing and hoses. To ensure that there is no contact with surrounding systems or components, it is a Boeing Commercial Aircraft requirement to maintain a minimum clearance envelope around all tubing in excess of expected motion.

"2) FAA Proposed 25.1435 Ruling - The proposed method of demonstrating compliance, proof pressure test to 3,400 psig, has been endorsed by the FAA in Advisory Circular 25-22 "Certification of Transport Aircraft Mechanical Systems", dated 14 March 2000, and proposal 12 to NPRM 96-6, "Proposed Rule and Notice 61 FR 35055 Revision of Hydraulic Systems Airworthiness Standards to Harmonize with European Airworthiness Standards for Transportation Category Airplanes, and Proposed Advisory Circular for Hydraulic System Certification Tests and Analysis", dated July 3, 1996. Proposal 12 would create a new requirement (25.1435(c)(3)) which would state:

"The complete hydraulic system(s) must be functionally tested on the airplane in normal operation over the range of motion of all associated user systems. The test must be conducted at the system relief pressure [or] 1.25 times DOP if a system pressure relief device is not part of the system design. Clearances between hydraulic system elements and other systems or structural elements must remain adequate and there must be no detrimental effects."

"3) Tube Deflection Due To Pressure - Tubing deflections due to pressurization are minimal and the differences in deflections when pressurized to 3,400 psig (23,440 kPa) versus 4,500 psig (31,030 kPa) are negligible.

"Tests conducted during the 777-200 program demonstrated that tube deflections are minimal and easily restrained. A laboratory test of a 35 inch (88.9 cm) long, 1 inch (2.54 cm) OD, 0.051 inch (0.13 cm) wall thickness, titanium tube with a 144o bend deflected 0.126 inch (0.32 cm) at the free end when 4,600 psig (31,720 kPa) was applied to the tube.

With 4,600 psig applied, the tube was bent back into shape (zero deflection) by applying 10.5 lbs (4.76 kg) to the free end of the tube. The same tube exhibited a deflection of 0.094 inches (0.24 cm) at 3,000 psig (20,680 kPa). With 3,000 psig applied to the tube it required 7.5 lbs (3.40 kg) to return the tube to it's original shape. What the test demonstrated was that very little force is required to maintain tubing routing under pressure, that force is easily provided by the clamp blocks installed to hold the tubing.

"4) Improved Design Processes - The Digital Pre-Assembly (DPA) buy-off checks implemented for the 777 installation drawing release process help ensure hydraulic system separation. DPA uses three-dimensional CATIA models as the means for all affected design disciplines to study, discover, and rectify systems interferences to ensure design requirements are met before, during and after design release. For the minor 777-200LR/-300ER changes discussed above, this process, combined with similarity to the 777-200 substantiates compliance with FAR 25.1435(b)(1).

"5) Precedent - In similar instances the FAA has agreed with the proposed exemption to pressure test hydraulic systems to 3,400 psig (23,440 kPa) in lieu of the current 4,500 psig (31,030 kPa) requirement. This means of demonstrating compliance has been approved for the 777-200, 737-700, 777-300, 757-300, 767-400ER, and 737-700C (FAA exemption numbers 5758, 6086, 6504, 6577, 6886, and 6889, respectively).

"Conclusion:

"In view of the substantiating factors detailed above,

Boeing asserts that the method of compliance proposed for FAR 25.1435(b)(1) for the 777-200LR/-300ER hydraulic power and distribution system provides, in the public interest, greater assurance of safe operation and hereby petitions the FAA to grant the subject exemption.

The method of compliance proposed for FAR 25.1435(b)(1) would be a 3,400 psig (23,440 kPa) proof pressure test for locations in the airplane with new tubing or significantly revised hydraulic tube rerouting as required by the 777 Hydraulic System Certification Plan.

"Please place the Exemption Petition on the Public Docket as soon as possible. A decision on the petition is requested by 1 July 2001."

A summary of the petition was published in the Federal Register on February 2, 2001 (66 FR 8841). No comments were received.

The Federal Aviation Administration's analysis/summary is as follows:

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 exemption.

Purpose of Section 25.1435(b)(1) Pressure Test. The FAA concurs with the petitioner's interpretation and the proposed alternate method of compliance.

FAA Proposed Section 25.1435 Ruling. The FAA concurs that it has endorsed the proposed method of compliance in its Advisory Circular No. AC 25-22, Certification of Transport Airplane Mechanical Systems, dated March 14, 2000, and that it is included in the harmonized proposed final rule and advisory circular.

Tube Deflection Due to Pressure. The FAA concurs that tubing deflections due to pressurization are minimal and the differences in deflections when pressurized to 3,400 psig versus 4,500 psig are negligible.

Improved Design Process. The FAA concurs that for the minor Boeing Model 777-200LR/777-300ER changes discussed earlier, this process combined with similarity to the Boeing Model 777-200 substantiates compliance with Section 25.1435(b)(1).

Precedent. The FAA concurs that the basis for the partial exemptions granted for Boeing Models 777-200, 737-700, 777-300, 757-300, 767-400ER, and 737-700C, and the substantiating factors, also apply to the Boeing Model 777-200LR and 777-300ER series airplanes hydraulic systems.

In consideration of the foregoing, I find that a partial grant of exemption is in the public interest. Therefore, pursuant to the authority contained in 49 U.S.C. Sections 40113 and 44701, delegated to me by the Administrator, the Boeing Company is hereby granted a partial exemption from 14 CFR Section 25.1435(b)(1) to the extent necessary to permit amended type certification of the Boeing Models 777-200LR and 777-300ER by conducting a 3400 psig (the system relief pressure) test of the modified or added hydraulic tubing runs and any rerouted sections while verifying that adequate clearances exist.

All test results pertinent to this exemption must be documented in a report and a copy provided to this office.