DOCKET NO.: SA-515
EXHIBIT NO. 8R

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

NTSB SAFETY RECOMMENDATIONS
A-96-74, -75, -76, AND -77
JULY 29,1996

WITH RELATED DOCUMENTS

(37 PAGES)

National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: July 29, 1996
In reply refer to: A-96-74 through -77

Honorable David R. Hinson
Administrator
Federal Aviation Administration
Washington, D.C. 20591

On July 6, 1996, Delta Air Lines flight 1288, a McDonnell-Douglas MD-88 airplane, experienced an uncontained failure of the No. 1 (left) engine front compressor front hub (fan hub) during takeoff at the Pensacola Regional Airport, Pensacola, Florida. Flight 1288 was a regularly scheduled passenger flight from Pensacola to Atlanta, Georgia, operating under the provisions of Title 14 Code of Federal Regulations (CFR) Part 121. On board the airplane were the 2 pilots, 3 flight attendants, and 142 passengers. The airplane was equipped with Pratt & Whitney JT8D-219 engines, which are part of the JT8D-200 engine series.

The captain rejected the takeoff following the engine failure and stopped the airplane on the departure runway. Engine fragments penetrated the aft fuselage, killing two passengers and seriously injuring one passenger. An engine fire ensued; however, it self-extinguished within moments. The investigation of this accident is continuing; however, information gathered thus far raises serious concerns for which immediate action is needed by the Federal Aviation Administration (FAA).

The investigation has determined that during the initial part of the takeoff roll, just as the engines were reaching peak thrust, the fan hub on the No. 1 engine separated into two large pieces; one was about 2/3 of the hub (containing 20 complete fan blade slots) and the other was about 1/3 of the hub (containing 12 fan blade slots). Other pieces of the fan hub, fan blades, and/or other engine debris penetrated the aft cabin area.

The fan hub design for the JT8D-200 series engine is different from other JT8D engines. According to Pratt & Whitney officials, about 2,600 JT8D-200 series fan hubs have been produced and are operating worldwide on about 1,200 MD-80 series airplanes.

Maintenance records at Delta Air Lines indicate that the fractured fan hub was inspected in December 1995, after accruing 12,693 flight cycles,[1] and was installed on the accident engine on December 29, 1995. The hub was inspected at Delta Air Lines using a florescent dye

[1] One flight cycle is equivalent to one takeoff and landing

penetrant inspection (FPI) procedure.[2] The hub failed at 13,835 cycles, which was 1,142 cydes since the last inspection. Maintenance records indicate that all work on the hub after delivery of the engine was performed by Delta

Metallurgical examination of the fan hub, part number 5000501-01, serial number R32971, at the Safety Board's Materials Laboratory revealed that the fracture originated in one of the 24 tierod holes in the hub. The tierod holes, which are aligned parallel to the engine shaft, are located around the circumference of the hub bore and alternate with 24 smaller diameter stress redistribution (SR) holes? The tierod and SR holes cannot be inspected without disassembling the fan hub from the engine. however, an inspection technique (eddy current) being developed by Delta Air Lines will permit inspection of the fan hub tierod holes "on-wing" without moving the fan hub into an engine shop!

The metallurgical examination showed that the hub separation stemmed from low cycle fatigue (LCF) cracking that originated from abusive machining[3] that created a localized area of ladder cracking and cold working of the underlying material in the microstructure inside one of the tierod holes about ½ inch from the aft face. A fatigue striation count using the scanning electron microscope disclosed a number of striations roughly equivalent to the total number of flight cycles for the fan hub. The number of striations and the appearance of the fracture surface suggest that the crack was present on the aft face of the hub for a distance of 0.46 inch at the time of the last FPI. The length of the crack along the wall of the hole was about 0.9 inch at the time of the FPI.

The investigation has revealed that the failed hub was manufactured in 1989 in Trollhattan, Sweden, by Volvo Flygmotor, which is the current manufacturer of Pratt & Whitney JT8D-200 series fan hubs A review of Volvo's records for the accident hub indicates that following manufacture, a blue etch anodize (BEA)[5] inspection and an FPI were performed on June 14, 1989. During BEA, mechanical marks were detected inside the tierod hole where the fatigue crack originated and were referred to a visual inspection process where the marks were accepted because the part satisfied all Pratt & Whitney BEA and visual inspection criteria The part was subsequently forwarded to Pratt & Whitney for installation into a production engine.

The Safety Board believes that the FAA should conduct a review of the processes used by Volvo and Pratt & Whitney that allowed a fan hub to be placed in service with anomalies that led to the failure of the hub on Delta flight 1288. Based on the review, the FAA should require as

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[2] FPI refers to the submersion of the hub into low Viscosity florescent dye bath, followed by washing with high viscosity solution. The florescent dye, which is retained by cracks or other surface defats, luminesces under black light inspection.

[3] "Stress redistribution holes" are sometimes referred to as balance weight holes, cooling holes, lightening holes, or shielding holes.

[4] The hub would be removed from the engine, although the engine would not be removed from the airplane.

[5] Local surface hardening and cracking created during the drilling of the holes.

[6] BEA is an inspection process intended to detect microstructure anomalies on the surface of a titanium component It is not intended to detect marks left by the machining process.

necessary that Pratt & Whitney m o d i its quality assurance standards and practices for inspection of the JT8D-200 series engine fan hubs.

The fact that the hub failed from fatigue cracking at the location of a BEA indication raises immediate concerns about other fan hubs that also had BEA indications during inspection and entered into airline service. However, on July 15, 1996, Pratt & Whitney advised the Safety Board that a review of the production records had identified six additional fan hubs in service that had exhibited similar BEA indications after manufacture. Pratt & Whitney immediately contacted the affected airlines and strongly urged them to remove those hubs from service before further flight. The airlines voluntarily complied with the request on July 15, 1996. On July 16,1996, the FAA formalized this action by issuing Airworthiness Directive (AD) 96-15-06 mandating removal of the six fan hubs from service. The six hubs are being forwarded to Pratt & Whitney for a detailed inspection and analyses to determine what corrective actions are required. The Safety Board is pleased that immediate actions to reduce the safety hazards associated with those hubs were taken.

Nonetheless, the Safety Board remains concerned about the potential for cracking in tierod holes in other JT8D-200 series fan hubs that may have been exposed to abusive machining or other damage that occurred during production or subsequent overhaul or rework that has not been detected by BEA and/or FPI inspections. Further, the Safely Board is concerned that fatigue cracking could also occur in the SR holes. Although the SR holes are smaller in diameter, and the related stresses should be less than in the tierod holes, the potential for catastrophic failure of the fan hub from undetected cracking in those holes should be addressed. The Safety Board is aware that inspection of the SR holes is complicated by the placement of balance. weights in some of the holes and that the removal of the weights leaves copper residue that makes eddy current inspection unreliable. Regardless, the Safety Board believes that the need *to* identify any fatigue cracking that may exist in the SR holes warrants cleaning and inspecting the SR holes.

The Safety Board is concerned that enhanced visual inspection techniques, including the FPI technique currently used for JT8D-200 series engine fan hubs, may not be adequately performed to detect cracking that can lead to catastrophic failure of the hub. The FPI method used at the Delta Air Lines engine repair station should have readily detected the crack on the surface of the aft face of the hub; however, there are mitigating circumstances that may have prevented the detection of the existing crack For example. FPI relies on an inspector visually detecting surface cracks in units that are typically crack free. According to Pratt & Whitney, there has never been a crack found on a JT8D-200 series fan hub during its service life. Consequently, the expectation of finding a crack is reduced. Moreover, the Safety Board is concerned that the procedures used by inspectors may make it difficult to view cracking in the tierod holes. Further, the training provided to the inspecton. which includes the syllabi and any visual aids, may not be sufficiently specific with regard to the most likely locations of cracks, orientation of a crack in a disk, the difficulty of detecting a crack in a hole (particularly high aspect ratio holes), and the appearance of cracks in rotating parts.

This accident, as well as past accident experience,' has shown that existing' cracks have been missed during other visual inspections using FPI. As a result, the Safety Board is concerned that procedures and inspector training and supervision may not be fully adequate to ensure reliable FPI of critical rotating engine parts. The Safety Board appreciates the important role of FPI in the inspection of critical aircraft parts, including the JT8D-200 series fan hub. Therefore, pending the development and implementation of a more definitive and reliable nondestructive inspection procedure, the FAA should review and revise, in conjunction with engine manufacturers and air carriers, the published guidance, inspection procedures, inspector training including any visual aids, and supervision currently in place for performing FPI and other nondestructive testing of high energy rotating engine parts. Particular emphasis should be placed on the FPI procedures for detecting cracks on JT8D-200 series fan hubs.

The Safety Board is aware that Pratt & Whitney is currently developing an eddy current inspection procedure for the JTSD-200 series fan hub tierod and SR holes to supplement the existing FPI technique being used by operators. Pratt & Whitney officials report that development and implementation of the eddy current inspection procedure to inspect the tierod and SR holes, may take "weeks or months" to complete. They also report that they intend for the newly developed procedure to be implemented as a "soft time" inspection whenever the engines are removed for other scheduled maintenance. The Safety Board believes that the eddy current inspection procedure in development at Delta Air Lines, in cooperation with Pratt & Whitney, that will permit "on-wing" inspection of fan hub tierod holes offers an opportunity to detect cracks in these holes in a relatively short time (reportedly 14 hours per engine) before a method involving inspection of all SR holes may be developed and implemented by Pratt & Whitney. Delta reportedly plans to begin this inspection as soon as it is fully developed and approved by Pratt & Whitney and the FAA. Such an "on-wing'' inspection may be the only means to inspect tierod holes in the fan hubs without substantial grounding of MD-80 airplanes because of the very limited number of spare hubs to replace hubs removed and taken into an engine shop.

Review of JT8D-200 engine fleet size, fan hub life cycle data, the crack propagation rate of the accident engine fan hub, and consultation with industry indicate that the proposed on-wing tierod hole eddy current inspection could be accomplished within the next 500 flight cycles with minimal impact on airline revenue service operations. Some data suggest that hubs that have between 10,000 and 15,000 cycles may be at greater risk than those with more than 15,000 cycles, the latter having passed the point where cracks caused by manufacturing flaws would be expected to cause failure of the hub. The Safety Board believes that inspection of all hubs with more than 10,000 cycles should be an FAA priority but that inspections should be prioritized to ensure that the fan hubs most at risk are inspected first.

Based on the evidence and data available at this time, the Safely Board believes that the FAA should require inspection of the tierod and SR bolt hole cracking potential in two stages. First, the FAA should require, on a schedule that would give priority to fan hubs presenting the highest risk, as an interim measure, within 500 cycles of the approval of a validated inspection

'Previous accidents in which inspecton failed to identify detectable fatigue cracks using FPI techniques: United Airlines DC-10, Sioux City, Iowa, GEAE CF6-6, July 19, 1989; Egypt Air A-300B4, GEAE CF6-50C2, April 10, 1995; and ValuJet DC-9, Atlanta, Georgia. Pratt & Whitney JT8D-9A, June 8. 1995

process that can be accomplished without having to send the fan hub to an engine shop, an eddy current inspection of the tierod holes of JT8D-200 series fan hubs that have accumulated over 10,000 cycles. Secondly, the FAA should require, as a terminating action, both an FPI and eddy current inspection of all fan hub tierod and SR holes. The scheduling of the redundant inspections should be commensurate with the risk associated with propagation of a fatigue crack from a manufacturing defect in the holes.

Therefore, as a result of its ongoing investigation of this accident, the National Transportation Safety Board recommends that the Federal Aviation Administration:

Require that, within 500 cycles of FAA approval of an engine "on Wing" eddy current inspection process for Pratt & Whitney JT8D-200 series engine fan hub tierod holes, this inspection be performed on those hubs that have accumulated more than 10,000 cycles since new, prioritize the inspections to ensure that the fan hubs most at risk (data suggest those hubs with 10,000 to 15,000 cycles since new) are inspected first. This inspection can be superseded by the redundant inspection urged in safety recommendation A-96-75. (Class I, Urgent Action) (A-96-74)

Require an inspection of all Pratt & Whitney JT8D-200 series engine fan hub tierod and stress redistribution holes by means of FPI and eddy current by a fixed number of flight cycles based on the risk of crack propagation fiom manufacturing flaws. (Class II, Priority Action) (A-96-75)

Review and modify the processes as necessary by which Volvo and Pratt & Whitney permitted JT8D-200 series fan hubs to be placed in airline service following indications of mechanical damage in the tierod holes based on a blue etch anodize inspection. (Class II, Priority Action) (A-96-76)

Review and revise, in conjunction with the engine manufacturers and air carriers, the procedures, training that includes the syllabi and visual aids, and supervision provided to inspectors for performing FPI and other nondestructive testing of high energy rotating engine parts, with particular emphasis on the JT8D-200 series tierod and stress redistribution holes. (Class I, Urgent Action) (A-96-77)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman

96-15-06

PRATT & WHITNEY

Amendment 39-9714 **Docket No. 96-ANE-1**

Applicability: Pratt & Whitney (PW) JT8D-200 series turbofan engines incorporating affected first stage fan hubs, Part Number (P/N) 5000501-01 identified by any of the following Serial Numbers:

T50693, T50823,
T50827, R32926,
R32960, P66756.

These engines are installed on but not .limited to McDonnell Douglas MD-80 series aircraft.

NOTE: This airworthiness directive (AD) applies to each engine identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For engines that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (b) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, 'the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless accomplished previously.

To prevent the initiation and propagation of a fatigue crack, fracture of the fan hub, uncontained engine failure, and damage to the aircraft, accomplish the following:

(a) Prior to further flight, remove from service all affected first stage fan hubs, P/N 5000501-01, identified by Serial Numbers listed in the applicability paragraph of this **AD,** and replace with serviceable parts.

(b) **An** alternative method of compliance or adjustment of compliance time that provides an acceptable level of safety may be used if approved by the Manager, Engine Certification Office. The request should be forwarded through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to **the** Manager, Engine Certification Office-

NOTE: Information concerning the existence of approved alternative methods of compliance with this airworthiness directive, if any, may be obtained from the Engine Certification Office.

(c) This amendment becomes effective September **3,** 1996, to all

persons except those persons to whom it was made immediately effective by priority letter AD 96-15-06, issued July 16, 1996, which contained the requirements of this amendment.

FOR FURTHER INFORMATION CONTACT:
Robert E. Guyotte, Manager, Engine Certification Branch, FAA, Engine and

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Propeller Directorate, 12 New England Executive Park, Burlington, MA 01803-5299; telephone (617) 238-7142, fax (617) 238-7199.

[Federal Register: October 4, 1996 (Volume 61, Number 194)]
[Proposed Rules]
[Page 51847-518491
From the Federal Register Online via GPO Access (wais.access.gpo.gov]

DEPARTMENT OF TRANSPORTATION
14 CFR Part 39

[Docket No. 96-ANE-33]
RIN 2120-AA64

Airworthiness Directives; Pratt & Whitney JT8D-200 Series Turbofan Engines

AGENCY: Federal Aviation Administration, DOT.

ACTION: Notice of proposed rulemaking (NPRM).

SUMMARY: This document proposes the adoption of a new airworthiness directive (AD) that is applicable to Pratt & Whitney JT8D-200 series turbofan engines. This proposal would require, for front compressor front hubs (fan hubs), cleaning; initial and repetitive eddy current (EC nt penetrant inspections (FPI) of tierod and counterweight holes for cracks; removal of bushings; the cleaning and ECI and FPI of bushed holes for cracks; and, if necessary, replacement with serviceable parts. In addition, this proposal would require reporting findings of cracked fan hubs. This proposal is prompted by a report of an uncontained failure of a fan hub. The actions specified by the proposed AD are intended to prevent fan hub failure due to tierod, counterweight, or bushed hole cracking, which could result in an uncontained engine failure and damage to the aircraft.

DATES: Comments must be received by November 4, 1996.

ADDRESSES: Submit comments in triplicate to the Federal Aviation Administration (FAA), New England Region, Office of the Assistant Chief Counsel, Attention: Rules Docket No. 96-ANE-33, 12 New England Executive Park, Burlington, MA 01803-5299. Comments may be inspected at this location between 8:00 a.m. and 4:30 p.m., Monday through Friday, except Federal holidays.

The service information referenced in the proposed rule may be obtained from Pratt & Whitney, 400 Main St., East Hartford, CT 06108; telephone (860) 565-6600, fax (860) 565-4503. This information may be examined at the FAA, New England Region, Office of the Assistant Chief Counsel, 12 New England Executive Park, Burlington, MA.

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FOR NRTHER INFORMATION CONTACT: Robert E. Guyotte, Manager, Engine Certification Branch, Engine Certification Office, FAA; Engine and Propeller Directorate, 12 New England Executive Park, Burlington, MA 01803-5299; telephone (617) 238-7142, fax (617) 238-7199.

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SUPPLEMENTARY INFORMATION:

Comments Invited

Interested persons are invited to participate in the making of the proposed rule by submitting such written data, views, or arguments as they may desire. Communications should identify the Rules Docket number and be submitted in triplicate to the address specified above. All communications received on or before the closing date for comments, specified above, will be considered before taking action on the proposed rule. The proposals contained in this notice may be changed in light of the comments received.

Comments are specifically invited on the overall regulatory, economic, environmental, and energy aspects of the proposed rule. All comments submitted will be available, both before and after the closing date for comments, in the Rules Docket for examination by interested persons. A report summarizing each FAA-public contact concerned with the substance of this proposal will be filed in the Rules Docket.

Commenters wishing the FAA to acknowledge receipt of their comments submitted in response to this notice must submit a self-addressed, stamped postcard on which the following statement is made: "Comments to Docket Number 96-ANE-33." The postcard will be date stamped and returned to the commenter.

Availability of NPRMs

Any person may obtain a copy of this NPRM by submitting a request to the FAA, New England Region, Office of the Assistant Chief Counsel, Attention: Rules Docket No. 96-ANE-33, 12 New England Executive Park, Burlington, MA 01803-5299.

Discussion

The Federal Aviation Administration (FAA) received a report of an uncontained failure of a front compressor front hub (fan hub), Part Number 5000501-01, installed on a Pratt & Whitney (PW) JT8D-200 series turbofan engine. The investigation revealed a localized work hardened layer found in the tierod hole of the fan hub from which a crack initiated and propagated to failure in low cycle fatigue. The FAA has determined that the work hardened layer was the result of a coolant channel drill using a single plunge drilling procedure during manufacture. This condition, if not corrected, could result in fan hub failure due to tierod or counterweight hole cracking, which could result in an uncontained engine failure and damage to the aircraft.

The FAA has reviewed and approved the technical contents of PW

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Accordingly, pursuant to the authority delegated to me by the Administrator, the Federal Aviation Administration proposes to amend part 39 of the Federal Aviation Regulations (14 CFR part 39) as follows:

PART 39--AIRWORTHINESS DIRECTIVES

1. The authority citation for part 39 continues to read as follows:

Authority: 49 USC 106(g), 40113, 44701.

Sec. 39.13 [Amended]

2. Section 39.13 is amended by adding the following new airworthiness directive:

Pratt & Whitney: Docket No. 96-ANE-33.

Applicability: Pratt & Whitney (PW) JT8D-209, -217, -217C, and -219 series turbofan engines, installed on but not limited to McDonnell Douglas MD-80 series aircraft.

Note: This airworthiness directive (AD) applies to each engine identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For engines that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (d) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Required as indicated, unless accomplished previously.

To prevent front compressor front hub (fan hub), Part Number 5000501-01, failure due to tierod, counterweight, or bushed hole cracking, which could result in an

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uncontained engine failure and damage to the aircraft, accomplish the following:

(a) Fan hubs with fewer than 4,000 cycles since new (CSN) on the effective date of this AD need not be inspected until accumulating 4,000 CSN. After the effective date of this AD, upon accumulating 4,000 CSN, perform the requirements of paragraph (b) of this AD.

(b) For fen hubs with 4,000 CSN, accomplish the following:

(1) For fan hubs identified by serial numbers (S/Ns) in Appendix A of PW Alert Service Bulletin (ASB) No. A6272, dated September 24, 1996, inspect for cracks in accordance with the initial inspection intervals of Table 1 of this AD, in accordance with the

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Maintenance Inspector, who may add comments and then send it to the Manager, Engine Certification Office.

Note: Information concerning the existence of approved alternative methods of compliance with this airworthiness directive, if any, may be obtained from the Engine Certification Office.

(e) Special flight permits may be issued in accordance with sections **21.197** and **21.199** of the Federal Aviation Regulations (14 CFR **21.197** and **21.199)** to operate the aircraft to a location where the requirements of this AD can be accomplished.

Issued in Burlington, Massachusetts, on September **27, 1996.**

James C. Jones,

Acting Manager, Engine and Propeller Directorate, Aircraft Certification Service.

[FR Doc. **96-25596** Filed **10-3-96; 8:45** am]

BILLING CODE **4910-13-U**

National Transportation Safety Board
Washington. D.C. 20594
Office of the Chairman

November 25, 1996

Federal Aviation Administration
New England Region
Office of the Assistant Chief Counsel
12 New England Executive Park
Burlington, Massachusetts 01803-5299

Attention: Rules Docket No. 96-ANE-33

Dear Sir:

The National Transportation Safety Board has reviewed your Notice of Proposed Rulemaking (NPRM), "Airworthiness Directives; Pratt & Whitney JT8D-200 series Turbofan Engines," which was published in 61 FR 51847 on October 4,1996. The notice proposes to adopt a new airworthiness directive (AD) to require initial and repetitive inspections of the compressor front fan hubs of Pratt & Whitney (P&W) JT8D-200 series turbofan engines. Inspection requirements include eddy current (ECI) and fluorescent penetrant (FPI) inspection of the fan hub tierod and counterweight holes for cracks.

Following the July 6, 1996, accident involving Delta Air Linea flight 1288 at Pensacola, Florida, the Safety Board issued Safety Recommendations A-96-74 and -75. In this accident, a McDonnell-Douglas MD-88 airplane equipped with P&W JT8D-219 engines experienced an uncontained failure of the No. 1 engine fan hub. Engine fragments killed two passengers and seriously injured one passenger. Although the investigation of this accident is still ongoing Safety Board investigators determined soon after the accident that the hub fracture had originated in one of the 24 tierod holes m the hub. Low cycle fatigue cracking had originated in a localized area of ladder cracking and cold working of the underlying material in the microstructure inside one of the tierod holes about ½ inch fiom the aft face. The crack had progressed to the hub surface where metallurgical analysis indicates that the surface crack length was about .46 inch when the fan hub was last inspected, 1,142 cycles before the accident. The fracture origin was created by 'abusive machining, which is local surface hardening and cracking created during the drilling process.

Based on these initial findings, the Safety Board recommended the following to the FAA:

> Require that, within 500 cycles of FAA approval of an engine "on wing" eddy ament inspection process for Pratt & Whitney JT8D-200 series

engine fan hub tierod holes, this inspection be performed on those hubs that have accumulated more than 10,000 cycles since new, prioritize the inspections to ensure that the fan hubs most at risk (data suggest those hubs With 10,000 to 15,000 cycles since new) are inspected first. This inspection *can* be superseded by the redundant inspection urged in safety recommendation *A-9675. (A-9674)*

Require an inspection of all Pratt & *Whitney* JT8D-200 series *engine* fan hub tierod and stress redistribution boles by means of FPI and eddy current by *a* fixed number of flight cydes based on the risk of crack propagation from manufacturing flaws. (A-9675)

As compared to the *Safety* Board recommendations, the *NPRM* proposes additional inspection steps, different initial inspection time criteria, and initial inspection requirements on only a limited number of hubs. The additional inspection steps augment and support the intent of the original recommendations and are fully supported by the Safety Board. The proposed initial inspection time criteria, based upon *a* table that ranges from 1,050 cycles to *965* cydes after the effective date of the AD, applies *only* to hubs produced using the coolant channel drill used on the accident hub.[1] The *Safety* Board supports this change, because further investigation has revealed that these hubs might have a higher risk of abusive machining damage, even though it *is* not clear that hubs drilled by coolant channel drills are the only suspect fan hubs. However, the *Safely* Board does not agree with the proposed inspection program for the remaining hub population

The NPRM proposes *a* requirement to inspect *only* those hubs whose tierod and *stress* redistribution holes were not drilled by coolant channel drills at each shop visit when the hub assembly *is* stripped to the piece-part level. The proposed initial inspection of these hubs may be as late as 10,000 operating cydes after the effective date of this AD. The Safety Board believes that these hubs are of nearly equal concern as the *first* group (drilled by the coolant channel drill) because it *has* not been *established* that only coolant channel drilled hubs are suspect and the proposed interval *is* too long to detect all potential cracks before they may be expected to propagate to failure. Such a failure would likely be uncontained and *a* serious threat to the airplane.

The reported incidence of abusive machining on fan hubs and dated parts has been rare, and the exact cause is *not* understood.[2] Also, there *is* no recognized non-destructive test that can reliably identify abusive machining.[3] Therefore, the possibility

[1] According to P&W, a total of 719 hubs, including the accident hub, had the tierod and counterweight holes drilled using a coolant channel drill. The remaining population of hubs still in service is approximately 1,901.

[2] There is one other documented case of fan hub failure resulting from abusive machining. It occurred on a P&W JT8D-7 engine and is described in P&W Materials Laboratory Report No. 82-200-0061-Z, April 5, 1982.

[3] Existing manufacturing inspection methods did not identify the damage that led to cracking and failure of the accident hub. The origin and characteristics of the fracture were determined after the accident by metallurgical sectioning (destructive inspection) of the fracture surface.

exist of damage in any hub regardless of the drilling process used. The Safety Board believes (and advised the FAA in its recommendation letter) that hubs with 10,000 to 15,000 cycles since new have the greatest risk of failure. This risk would apply to all hubs that may have been damaged during drilling, not just the one considered at higher risk because of the type of drill used during manufacture.

Because a single additional fatigue failure of a JT8D-200 series engine fan hub is an unacceptable event, the Safety Board proposes that the reinspection occur at the next shop visit for all of those hubs that have between 10,000 and 15,000 cycles since new, regardless of the type of drill used during manufacture.

The Safety Board believes that amending the AD as stated above will significantly reduce the risk of another fatigue failure of the P&W JT8D-200 series fan hub.

The Safety Board appreciates the opportunity to comment on this proposed rule.

Sincerely,

[redacted]

Jim Hall
Chairman

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U.S. Department of Transportation
Federal Aviation Administration

Office of the Administrator

800 Independence Ave., S.W.
Washington, D.C. 20591

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A-96-74 thru -77
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Frechette

OCT 10 1996

The Honorable James E. Hall
Chairman, National Transportation
Safety Board
490 L'Enfant Plaza East, SW.
Washington, DC 20594

Dear Mr. Chairman:

This is in response to Safety Recommendations A-96-74 through -77 issued by the Board on July 29, 1996. These safety recommendations were issued as a result of an accident on July 6, 1996, involving Delta Air Lines Flight 1288, a McDonnell Douglas MD-88. The airplane experienced an uncontained failure of the No. 1 (left) engine front compressor front hub (fan hub) during takeoff at the Pensacola Regional Airport, Pensacola, Florida. Flight 1288 was a regularly scheduled passenger flight from Pensacola to Atlanta, Georgia, operating under the provisions of 14 CFR Part 121. On board the airplane were the 2 pilots, 3 flight attendants, and 142 passengers. The airplane was equipped with Pratt & Whitney JT8D-219 engines, which are part of the JT8D-200 engine series.

A-96-74. Require that, within 500 cycles of FAA approval of an engine "on wing" eddy current inspection process for Pratt & Whitney JT8D-200 series engine fan hub tierod holes, this inspection be performed on those hubs that have accumulated more than 10,000 cycles since new; prioritize the inspections to ensure that the fan hubs most at risk (data suggest those hubs with 10,000 to 15,000 cycles since new) are inspected first. This inspection can be superseded by the redundant inspection urged in safety recommendation A-96-75.

FAA Comment. The Federal Aviation Administration (FAA) is in general agreement with the Board on the need for an eddy current inspection of the fan hub tierod holes but believes that the eddy current inspection must also be extended to the counterweight holes to ensure that the individual fan hub can be cleared for continued operation. In order to understand the FAA's program for the fan hub, it is necessary to review the analysis done on the issue.

The fractured fan hub, part number 5000502-01, was manufactured in June 1989 by Volvo Flygmotor (Volvo) in Trollhattan, Sweden. Volvo produced a total of 2,379 JT8D-200 series fan hubs.

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Initial review of manufacturing records revealed seven hubs with blue etch anodized inspection indications and one fan hub with a fluorescent penetrant inspection indication. Two of the eight hubs had been scrapped during manufacture, and six of the hubs were dispositioned and placed into airline service. These six hubs were removed from service as directed by Priority Letter Airworthiness Directive (AD) **96-15-06** issued on July **16, 1996.**

Further record investigation concluded that work hardened material was potentially caused by a coolant channel drill used in the first step of tierod hole production. The use of coolant channel drills occurred February 11, **1989**, through September **14, 1990**, and February **26, 1991**, through March **31, 1991**, with a total population of **779** fan hubs produced. Volvo suspended the use of coolant channel drills due to the high incidences of tool burning, tool breaking, and dimensional deviation. Sixty fan hubs were scrapped during production **(37** fan hubs prior to blue etch anodize inspection and 23 fan hubs for various reasons). The majority of fan hubs **(1,591)** produced by Volvo were manufactured with standard drills.

The drilling processes are very different between the use of standard drills and coolant channel drills. **A** coolant channel drill has two internal passages which carry coolant through two holes at the tip of the drill. The coolant flushes the titanium chips formed by the drill tip up through the drill flutes during a one-step plunge drilling process (i.e., continuous feed). Used coolant channel drills have been found with titanium transfer on the drill indicating titanium chips were not cleanly flushed from the hole during drilling. A standard drill applies coolant external to the drill and utilizes a multiple step drilling process where approximately ***0.25*** inches of material are removed before the drill is retracted from the hole to aid in the removal of titanium chips. Drilling is continued at the **0.25** inch rate with drill retraction for chip removal until manufacture of the hole is complete.

Manufacturing records indicated 91 fan hubs were produced by Pratt & Whitney, and ***580*** fan hubs were produced by Atlantic Machining. The record search of the **91** Pratt **&** Whitney fan hubs and the 580 Atlantic Machining fan hubs indicated no inspection indications were noted. The fan hubs produced by Pratt & Whitney and Atlantic Machining were manufactured using the standard drill.

Pratt & Whitney and Volvo conducted drilling tests on titanium specimens with coolant channel drills and were successful in replicating the work hardened material observed on the failure disk. Blue etch anodized inspection of the replicated surface

was also performed which demonstrated the ability of the blue etch anodized process to detect this type of defect.

The six fan hubs removed from service in accordance with AD 96-15-06 were fluorescent penetrant, eddy current, and blue etch anodized inspected at Pratt & Whitney. Although multiple inspection indications were found, the cracks were caused by service use. Pratt & Whitney was unable to correlate the indications with those noted at manufacture. All of the six fan hubs were sectioned and underwent a metallurgical analysis. No cracks were present, and no work hardened material was found.

The **FAA** has concluded that three distinct populations exist within the 3,050 fan hubs manufactured which can be categorized by susceptibility to work hardened material as follows:

- Category 1 (highest risk--9 fan hubs plus failed fan hub)--fan hubs found to have blue etch anodized inspection indications which were dispositioned as acceptable for airline service.

- Category 2 (next highest risk--779 fan hubs)--fan hubs with tierod and counterweight holes produced by coolant channel drills.

- Category 3 (lowest risk--2,262 fan hubs)--fan hubs with tierod and counterweight holes produced by standard high speed drills.

  NOTE: Number of fan hubs are based on number of fan hubs produced.

Consequently, while the **FAA** is in agreement that an eddy current inspection of the fan hub tierod holes is needed, it has also concluded that the eddy current inspection must be extended to the counterweight holes. The stress levels found in the counterweight holes, although lower than tierod holes, are sufficient that work hardened material could result in crack initiation and propagation in low cycle fatigue. It should also be noted that the manufacturing process for producing both tierod and counterweight holes are identical.

The **FAA** does not believe that an eddy current inspection can be performed "on wing" and has concluded that the inspection of the fan hub can only be accomplished through disassembly and fan hub removal, inspection, and engine reassembly. The fan hub **removal may** be accomplished with the engine installed on the airplane since the removal of the fan **hub** with the **engine** attached to the airplane does not inherently increase the risk

of a problem occurring when proper maintenance manual procedures are followed.

It is important, however, to ensure proper fan tierod, counterweight, and bush hole surface preparation and to provide a reasonable environment for fan hub handling and the conduct of the eddy current inspection. Inspection of counterweight holes, which contain remnant copper left by balance weight occupation, requires removal of the copper on the hole surface prior to eddy current inspection. The removal process includes positioning the disk to place the hole axis in a vertical position, plugging the bottoms of the affected holes, and pouring a nitric acid solution (PS-11) into the holes. After working for 10 minutes, the plugs are removed and the holes are water-flushed with the required collection and controlled disposal of the contaminated liquid.

Inspection of the tierod and counterweight holes which exhibit signatures of cosmetic damage (i.e., superficial scoring or scratches on the hole surfaces) are subjected to a tightly controlled butterfly polish operation and then reinspected. A high speed rotary air motor (≈18,000 RPM) is used to perform the butterfly polish operation.

Pratt & Whitney currently has procedures for the inspection of holes with bushings. These procedures include the processes required for bushing removal, surface cleaning, and preparation for eddy current inspection. Acceptance and rejection criteria have been established for over-sized holes.

The fleet management program for Category 2 fan hubs is based on Pratt & Whitney's risk analysis which provides conservative initial and repeat inspection intervals for three program options to allow flexibility for the airlines in selecting a program to meet their fleet needs. The FAA is, therefore, requiring Category 2 fan hubs (by serial number) be removed and inspected in accordance with Pratt & Whitney Alert Service Bulletin No. A6272 dated September 24, 1996. On September 27, 1996, the FAA issued a notice of proposed rulemaking (NPRM) proposing to adopt an airworthiness directive to require compliance with this inspection. I have enclosed copies of the service bulletin and the NPRM for the Board's information. The FAA has concluded that the corrective action outlined in Pratt & Whitney's Alert Service Bulletin provides an alternative solution which exceeds the safety goal established by the Board's recommendation.

I will provide the Board with a copy of the final regulatory document as soon as it is issued.

A-96-75. Require an inspection of all Pratt & Whitney JT8D-200 series engine fan hub tierod and stress redistribution holes by

means of FPI and eddy current by a fixed number of flight cycles based on the risk of crack propagation from manufacturing flaws.

FAA Comment. The FAA agrees that an enhanced inspection of the tierod and counterweight holes needs to be conducted. Category 3 fan hubs will be required to have a fluorescent penetrant and eddy current inspection at piece-part exposure prior to accumulating 10,000 cycles from the effective date of the AD in response to Safety Recommendation A-96-74. The inspection interval has been determined by Pratt & Whitney's risk analysis using conservative assumptions and achieves the necessary safety goals. This action is included in the NPRM in response to Safety Recommendation A-96-74.

I consider the FAA's action to be completed on this safety recommendation.

A-96-76. Review and modify the processes as necessary by which Volvo and Pratt & Whitney permitted JT8D-200 series fan hubs to be placed in airline service following indications of mechanical damage in the tierod holes based on a blue etch anodize inspection.

FAA Comment. The FAA agrees with this safety recommendation. A review of Pratt & Whitney's quality assurance system and Volvo fan hub processes was conducted. The FAA has determined that Pratt & Whitney Quality Standard EIS-13, Blue Etch Anodized Disk, Hubs, Couplings, Blade Retainers, Rotating Air Seals, and Rotating Spacers, must be revised to include "standard masters" which depict rejectable conditions for work hardened material. The "standard masters" are being prepared for the work hardened material conditions and will be implemented by October 15, 1996. Additionally, Pratt & Whitney is currently expanding the Materials Control Laboratory Manual, Section E-166, Evaluation of Machined Features, to include examples of abusive machining utilizing 1X photographs. Pan hubs currently in production will be inspected to the intent of the new standard which will be introduced in October 1996. Quality deficiencies identified as findings and observations were documented in a Letter of Investigation and provided to Pratt & Whitney for corrective action. All corrective actions will be completed and institutionalized by March 1, 1997.

I will keep the Board apprised of the FAA's progress on this safety recommendation.

A-96-77. Review and revise, in conjunction with the engine manufacturers and air carriers, the procedures, training that includes the syllabi and visual aids, and supervision provided to inspectors for performing FPI and other non-destructive testing of high energy rotating engine parts, with particular

emphasis on the JT8D-200 series tierod and stress redistribution holes.

FAA Comment. The FAA agrees with this safety recommendation. A special evaluation team conducted a fluorescent penetrant inspection review of the Delta Air Lines facility located in Atlanta, Georgia, for critical rotating components. The FAA is satisfied that Delta Air Lines has the proper guidance for training and qualifying personnel in nondestructive testing methods and the performance of fluorescent penetrant inspections. The FAA will conduct an evaluation to examine other facilities which do fluorescent penetrant inspections and other nondestructive testing of high energy rotating parts with the objective of determining what changes are necessary to ensure proper implementation of the procedures. The National Resource Specialist for Nondestructive Evaluation, Engine and Propeller Directorate, Aircraft Certification Service, and representatives from the Flight Standards Service are developing a 6-month action plan that would evaluate six additional fluorescent penetrant inspection facilities to determine whether systemic problems exist in guidance material or its implementation and develop corrective actions as necessary.

I will keep the Board apprised of the FAA's progress on this safety recommendation.

Sincerely,

[redacted]

David R. Hinson
Administrator

Enclosures

FEB 27 1997

Honorable Barry L. Valentine
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

Dear Mr. Valentine:

Thank you for the Federal Aviation Administration's (FAA) response of October 10, 1996, to the National Transportation Safety Board's Safety Recommendations A-96-74 through -77.

Safety Recommendation A-96-74 asked the FAA to require that Within 500 cycles of FAA approval of an engine on-wing eddy current inspection process for Pratt & Whitney (PWA) JT8D-200 series engine fan hub tierod holes, this inspection be performed on those hubs that have accumulated more that 10,000 cycles since new; prioritize the inspections to ensure that the fan hubs most at risk (data suggest those hubs with 10,000 to 15,000 cycles since new) are inspected first. This inspection can be superseded by the redundant inspection urged in Safety Recommendation A-96-75.

The FAA generally agrees that an eddy current inspection of the fan hub tierod holes is needed. However, the FAA believes that the counterweight holes should not be considered separately, and since counterweight hole preparation and inspection is a detailed process that requires fan hub manipulation as well as a special environment, an on-wing procedure is not considered viable.

The Safety Board is concerned about the timeliness of the inspection of fan hubs most at risk. The Board's recommendation cited an on-wing eddy current inspection for the tierod holes in lieu of a complete removal, disassembly, and inspection of the fan hubs to ensure the integrity of at least the tierod holes as soon as possible with minimal impact to the operators. The Safety Board understands that the stress levels are higher in the tierod holes than the counterweight holes. Therefore, the Safety Board recommended a quick on-Wing eddy current inspection of the higher stressed tierod holes, followed by a thorough fluorescent dye penetrant inspection (FPI) and eddy current inspection of the entire hub at a more convenient time. Since the on-wing inspection is not considered viable, the FAA proposes the removal, cleaning, and initial and repetitive eddy current and FF'I of certain fan hubs in lieu of an on-wing inspection procedure.

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The FAA has concluded that following a review of the manufacturing records of the JT8D series 200 fan hubs, three distinct populations exist within the 3,050 fan hubs that have been categorized by susceptibility to abusive machining. There are 8 hubs that had inspection indications' during manufacture (Category 1--highest risk), 719 fan hubs with tierod and counterweight holes installed by coolant channel drills (Category 2--next highest risk), and 2,262 fan hubs with tierod and counterweight holes installed by standard high-speed Prills (Category 3--lowest risk). All Category 1 hubs were removed from service by Priority Letter Airworthiness Directive (AD) 96-15-06 issued on July 16, 1996.

The initial inspection and the reinspection intervals for the fleet management programs for Category 2 and 3 fan hubs are cited in PWA Alert Service Bulletin (ASB) No. A6272, and are based on PWA's risk analysis. For Category 2 fan hubs, the initial inspection is optional depending on the desired reinspection interval and can be: 1,050 cycles with a reinspection interval between 2,500 and 6,000 cycles; or 990 cycles with a reinspection interval between 2,500 and 8,000 cycles; or 965 cycles with a reinspection interval between 2,500 and 10,000 cycles. For Category 3 fan hubs, the inspection is recommended the next time the hub detail is available in the shop, but the hub is not to exceed 10,000 cycles of operation following the effective date of the ASB.

The Safety Board agrees that the removal, cleaning, and initial and repetitive eddy current and FPI at the interval cited in ASB No. 6272 for Category 2 fan hubs in lieu of an on-wing inspection procedure is appropriate. Based upon the FAA's action, the Safety Board classifies Safety Recommendation A-96-74 "Open--Acceptable Alternate Response."

Safety Recommendation A-96-75 asked the FAA to require an inspection of all Pratt & Whitney JT8D-200 series engine fan huh tierod and stress redistribution holes by means of FPI and eddy current by a fixed number of flight cycles based on the risk of crack propagation from manufacturing flaws.

The investigation of the Delta Air Lines flight 1288 accident revealed that a localized work-hardened layer was found in the tierod hole of the fan hub from which a crack initiated and propagated to failure after 13,835 flight cycles in low cycle fatigue (LCF). The FAA has determined that the work-hardened layer was the result of a coolant channel drill using a single plunge drilling process and that the titanium chips were not cleanly flushed from the hole during the drilling process. The FAA resolved that the chips became wedged between the hole wall and drill shank, which caused a localized, work-hardened layer.

Previous to the accident, on February 17, 1982, a fan hub on a Pan American World Airways Boeing 727 (B-727) with a PWA JT8D-7B engine experienced an uncontained failure during *takeoff* at Miami International Airport, Miami, Florida. Postaccident analysis of the failed fan hub revealed that a crack developed from an area of abusive machining in one of the

[1] The investigation of the accident involving Delta Air Lines flight 1288, in Pensacola, Florida, on July 6, 1996, has revealed that during manufacture, seven fan hubs had blue etch anodized inspection indications and one fan hub had fluorescent dye penetrant inspection indications.

installed with a standard drill using the multi-step drilling process rather than a coolant channel drill and the single plunge process. Although the Pan American accident hub was fiom a smaller JT8D-7 series engine, the titanium alloys were identical, and the hub design was similar to the JT8D-200 series engine, which incorporates deep tierod holes that pass through the thick rim section.

Because of the similarities between the Delta MD-88 and the PanAm B-727 fan hubs and the failures of those fan hubs, the Safety Board disagrees with the FAA's conclusion that the work-hardened layer on the tierod hole wall can only be the result of a coolant channel drill using a single plunge drilling procedure. The Safety Board believes that hubs classified as "Category 3" by the FAA should not be considered separately fiom Category 2 hubs. Because the FAA did not provide for any initial inspection of Category 3 hubs in the notice of proposed rulemaking issued on September 27, 1996, the Safety Board classifies Safety Recommendation A-96-75 "Open–Unacceptable Response."

Safety Recommendation A-96-76 asked the FAA to review and modify the processes as necessary by which Volvo and Pratt & Whitney permitted JT8D-200 series fan hubs to be placed in airline service following indications of mechanical damage in the tierod holes based on a blue etch anodize (BEA) inspection.

The Safety Board notes the "standard masters" that depict rejectable conditions for work-hardened material are being revised for BEA disks, hubs, couplings, blade retainers, rotating air seals, and rotating spacers. Also, Pratt & Whitney is expanding the Materials Control Laboratory Manual to include photographs as examples of abusive machining. Finally, fan hubs currently in production are inspected to the new standard. Because the FAA's actions are responsive to the intent of the recommendation, the Safety Board classifies Safety Recommendation A-96-76 "Closed--AcceptableAction."

Safety Recommendation A-96-77 asked the FAA to review and revise, in conjunction with the engine manufacturers and air carriers, the procedures, training that includes the syllabi and visual aids, and supervision provided to inspectors for performing FPI and other nondestructive testing of high-energy rotation engine parts, with particular emphasis on the JT8D series tierod and stress redistribution holes.

The FAA states that it has conducted an inspection review of the Delta Air Lines facility in Atlanta, Georgia, for critical rotating components, and is satisfied that Delta Air Lines has the proper guidance for training and qualifying personnel in nondestructive testing methods and the performance of FPI. Additionally, the FAA is developing a 6-month action plan to conduct an evaluation of other facilities that do FPI and other nondestructive testing of high-energy rotating

parts. Therefore, based upon the FAA's action. the Safety Board classifies Safety Recommendation A-96-77 "Open--Acceptable Response."

Sincerely,

ORIGINAL SIGNED BY
JIM HALL

Jim Hall
Chairman

cc: Dr. Donald R. Trilling, Director
Office of Environment, Energy and Safety

JFrechette: AS-40 1 1/7/96: draft: jwd: 12/2/96:revised:2/14/97:rnu:final 2/24/97:rnu
mc961229, Not. 6725A, Recs A-96-74 thru 77
cc: C(2), GA, PA, AS-1, AS-6, AS-40, SR-1(2)
proofread by S. Kell 2/25/97

[Federal Register: February 3, 1997 (Volume 62, Number 22)]
[Rules and Regulations]
[Page 4902-49041
From the Federal Register Online via GPO Access (wais.access.gpo.gov)
[DOCID:fr03fe97-4]

DEPARTMENT OF TRANSPORTATION
14 CFR Part 39

[Docket No. 96-ANE-33; Amendment 39-9896; AD 97-02-11]
RIN 2120-AA64

Airworthiness Directives; Pratt & Whitney JT8D-200 Series Turbofan Engines

AGENCY: Federal Aviation Administration, DOT.

ACTION: Final rule.

SUMMARY: This amendment adopts a new airworthiness directive (AD), applicable to Pratt & Whitney (PW) JTBD-200 series turbofan engines, that requires, for front compressor front hubs (fan hubs), cleaning; initial and repetitive eddy current (ECI) and fluorescent penetrant inspections (FPI) of tierod and counterweight holes for cracks; removal of bushings; the cleaning and ECI and FPI of bushed holes for cracks; and, if necessary, replacement with serviceable parts. In addition, this AD requires reporting the findings of cracked fan hubs. This amendment is prompted by a report of an uncontained failure of a fan hub. The actions specified by this AD are intended to prevent fan hub failure due to tierod, counterweight, or bushed hole cracking, which could result in an uncontained engine failure and damage to the aircraft.

DATES: Effective March 5, 1997.
The incorporation by reference of certain publications listed in the regulations is approved by the Director of the Federal Register as of March 5, 1997.

ADDRESSES: The service information referenced in this AD may be obtained from Pratt & Whitney, 400 Main St., East Hartford, CT 06108; telephone (860) 565-6600, fax (860) 565-4503. This information may be examined at the Federal Aviation Administration (FAA), New England Region, Office of the Assistant Chief Counsel, 12 New England Executive Park, Burlington, MA; or at the Office of the Federal Register, 800 North Capitol Street, NW., Suite 700, Washington, DC.

FOR FURTHER INFORMATION CONTACT: Diane Cook, Aerospace Engineer, Engine certification Office, FAA, Engine and Propeller Directorate, 12 New England Executive Park, Burlington, MA 01803-5299; telephone (617) 238-7134, fax (617) 238-7199.

SUPPLEMENTARY INFORMATION: A proposal to amend part 39 of the Federal Aviation Regulations (14 CFR part 39) to include an airworthiness

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directive (AD) that is applicable to Pratt & Whitney (PW) JT8D-200 series turbofan engines was published in the Federal Register on October 4, 1996 (61 FR 51847). That action proposed to require cleaning, initial and repetitive eddy current inspections (ECI) and fluorescent penetrant inspections (FPI) for cracks of tierod and counterweight holes; removing bushings; initial and repetitive ECI and FPI of bushed holes for cracks; and, if necessary, replacing with serviceable parts. The compliance requirements allow selection of inspection schedules depending on fan hub S/Ns listed in PW Alert Service Bulletin (ASB) No. A6272, dated September 24, 1996,' and includes an inspection schedule for those fan hubs whose S/Ns are not listed in the ASB. In addition, the proposed AD requires reporting the number of initial inspections and the findings of cracked fan hubs.

Interested persons have been afforded an opportunity to participate in the making of this amendment. Due consideration has been given to the comments received.

One commenter states that the Notice of Proposed Rulemaking (NPRM) as written was confusing and subject to interpretation, and offered a number of editorial suggestions. The FAA reviewed the suggestions and concurs in part with the changes.

The commenter states that the applicability should be expressed to the lowest practical level by including the phrase "front compressor front hub (fan hub)" and its corresponding part number in the applicability statement. The FAA concurs. The applicability section in this final has been revised to read "* * * engines with front compressor front hub (fan hub) Part Number 5000501-01 installed".

The commenter states that a stronger statement regarding the initial inspections for fan hubs with less than 4,000 cycles since new (CSN) was

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needed. The cornenter suggests adding the intent of the first note on page 8 of PW ASB No. A6272, dated September 24, 1996, which requires inspection after the fan hub has accumulated more than 4,000 cycles in service. This change would eliminate the need for paragraph (a) of the proposed rule. The FAA concurs. The structure of the compliance section in this final rule has been modified to include the initial 4,000 CSN inspection requirement in the beginning of each of two compliance paragraphs. Paragraph (a) of this final rule will cover coolant channel drilled (CCD) fan hubs identified by S/N in the SB, and paragraph (b) for inspection of all other affected fan hubs. For each population of hubs, the initial inspection must not be completed until the fan hub has accumulated more than 4,000 CSN.

The commenter states that paragraph (c) of the NPRM is vague and should specify what is to be reported. The FAA concurs and has added the requirement of reporting in accordance with Accomplishment Instructions, Paragraph 8, of Attachment 1 to PW ASB No. A6272, dated September 24, 1996, to this final rule.

The commenter states that paragraph (a) and Table 1 of the NPRM do not clearly indicate that the operator is to choose one of the three options in Table 1 and stick with the corresponding reinspection interval. The commenter suggests adding "or" after options 1 and 2 in Table 1 and adding a note to require that the operator follow the initial and repetitive requirements of the option chosen. The FAA concurs in part. The "or" has been added as suggested. The original proposal contained such a requirement in proposed paragraph (b)(1)(i), which has been carried over into new paragraph (a)(2). Operators must follow the repetitive inspection interval corresponding to the selected initial inspection time.

The commenter states that the time limit for reporting in paragraph

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(c) of the NPRM is unreasonable because its administrative personnel do not work on weekends and during holiday periods. The commenter recommends a 10 day limit for reporting. The FAA does not concur. A **48** hour period should be adequate and is a standard reporting requirement time limit in ADs. The AD does not require that only administrative personnel submit the report to the FAA.

Two commenters, including the National Transportation Safety Board, state that they agree with the NPRM's proposed initial and repetitive inspection program on the population of hubs that were produced using the CCD procedure, based on the investigation that indicates that these hubs may have a higher risk of abusive machining damage. However, since the commenters do not agree that CCD hubs are the only suspect fan hubs, the commenters do not agree with the proposed inspection program for the remaining hub population. The NPRM proposed to inspect the remaining population (those hubs not CCD) when the hub assembly is stripped to the piece part level. The commenters are concerned that this proposal may allow hubs to be initially inspected as late as 10,000 cycles in service (CIS) after the effective date of this AD. The cornenters believe that these hubs are of nearly equal concern as the fan hubs produced by CCD and the proposed interval is too long to detect all potential cracks before they may be expected to propagate to failure. The cornenters propose that inspection/reinspection occur at the next shop visit for all of those hubs that have between 10,000 and 15,000 CIS since new regardless of the type of drill used during manufacture.

The **FAA** does not concur at this time. The **FAA's** analysis of this problem indicates that hubs manufactured using coolant-channel drills are more susceptible to work hardened areas in the tierod and counterweight holes that could serve as a crack origin. The FAA concludes, therefore, that it is logical to treat these two distinct populations of compressor hubs differently in terms of when operators must perform the required inspections. Requiring all hubs to be inspected according to the CCD schedule is not supported by the available data. The investigation, however, continues and should any additional data become available, the FAA may initiate further rulemaking as required.

After careful review of the available data, including the comments noted above, the FAA has determined that air safety and the public interest require the adoption of the rule with the changes described previously. The **FAA** has determined that these changes will neither increase the economic burden on any operator nor increase the scope of the AD.

There are approximately **2,624** engines of the affected design in the worldwide fleet. The **FAA** estimates that **1,279** engines installed on aircraft of U.S. registry will be affected by this AD, that it will take approximately **20** work hours per engine for 360 engines to disassemble, remove, inspect, and reassemble engines, and **4** work hours per engine for **919** engines to inspect at piece-part exposure, and that the average labor rate is $60 per work hour. Based on these figures, the total cost impact of the AD on U.S. operators is estimated to be **$862,560.**

The regulations adopted herein will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. Therefore, in accordance with Executive Order **12612**, it is determined that this final rule does not have sufficient federalism implications to warrant the preparation of a Federalism Assessment.

For the reasons discussed above, I certify that this action (1) is not a "significant regulatory action" under Executive Order **12866;** (2) is not a "significant rule" under DOT Regulatory Policies and

Procedures (44 FR 11034, February 26, 1979); and (3) will not have a significant economic impact, positive or negative, on a substantial number of small entities under the criteria of the Regulatory Flexibility Act. A final evaluation has been prepared for this action and it is contained in the Rules Docket. A copy of it may be obtained from the Rules Docket at the location provided under the caption ADDRESSES.

List of Subjects in 14 CFR Part 39

Air Transportation, Aircraft, Aviation safety, Incorporation by reference, Safety.

Adoption of the Amendment

Accordingly, pursuant to the authority delegated to me by the Administrator, the Federal Aviation Administration amends part 39 of the Federal Aviation Regulations (14 CFR part 39) as follows:

PART 39--AIRWORTHINESS DIRECTIVES

1. The authority citation for part 39 continues to read as follows:

Authority: 49 U.S.C. 106(g), 40113, 44701.

Sec. 39.13 [mended]

2. Section 39.13 is amended by adding the following new airworthiness directive:

97-02-11 Pratt & Whitney: Amendment 39-9896. Docket 96-ANE-33.

Applicability: Pratt & Whitney JT8D-209, -217, -217C, and -219 series turbofan engines with front compressor front hub (fan hub), Part Number (P/N) 5000501-01, installed. These engines are installed on but not limited to McDonnell Douglas MD-80 series aircraft.

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Note 1: This airworthiness directive (AD) applies to each engine identified in the preceding applicability provision, regardless of whether it has been modified, altered, or repaired in the area subject to the requirements of this AD. For engines that have been modified, altered, or repaired so that the performance of the requirements of this AD is affected, the owner/operator must request approval for an alternative method of compliance in accordance with paragraph (e) of this AD. The request should include an assessment of the effect of the modification, alteration, or repair on the unsafe condition addressed by this AD; and, if the unsafe condition has not been eliminated, the request should include specific proposed actions to address it.

Compliance: Reauired as indicated, unless accomplished previously.

To prevent front compressor front hub (fan hub) failure Clue to tierod, counterweight, or bushed hole crackina, which could result in an uncontained engine failure and damage to the aircraft, accomplish the following:

(a) For fan hubs identified by serial numbers (S/Ns) in Appendix

A of PW Alert Service Bulletin (ASB) No. A6272, dated September 24, 1996, after the fan hub has accumulated more than 4,000 cycles in service since new (CSN), accomplish the following:

(1) Select an initial inspection interval from Table 1 of this AD and inspect for cracks in accordance with the Accomplishment Instructions, Paragraph A, Part 1, and, if applicable, Paragraph B, of PW ASB No. A6272, dated September 24, 1996.

(2) Reinspect at the interval in Table 1 of this AD that corresponds to the selected initial inspection interval, and in accordance with the Accomplishment Instructions, Paragraph A, Part 1, and, if applicable, Paragraph B, of PW ASB No. A6272, dated September 24, 1996.

Table 1

Initial inspection	Reinspection
1. Within 1,050 cycles in service (CIS) after the effective date of this AD, or prior to accumulating 5,050 CSN, whichever occurs later.	After accumulating 2,500 CIS since last inspection, but not to exceed 6,000 CIS since last inspection.
OR	
2. Within 990 CIS after the effective date of this AD, or prior to accumulating 4,990 CSN, whichever occurs later.	After accumulating 2,500 CIS since last inspection, but not to exceed 8,000 CIS since last inspection.
OR	
3. Within 965 CIS after the effective date of this AD, or prior to accumulating 4,965 CSN, whichever occurs later.	After accumulating 2,500 CIS since last inspection, but not to exceed 10,000 CIS since last inspection.

(b) For fan hubs with S/Ns not listed in Appendix A of PW ASB No. A6272, dated September 24, 1996, after the fan hub has accumulated more than 4,000 CSN, inspect at the next time the fan hub is in the shop at piece-part level, but not to exceed 10,000 CIS after effective date of this AD in accordance with the Accomplishment Instructions, Paragraph A, Part 2, and, if applicable, Paragraph B, of PW ASB No. A6272, dated September 24, 1996.

(c) Remove from service fan hubs found cracked or fan hubs that exceed the bushed hole acceptance criteria in accordance with PW ASB No. A6272, dated September 24, 1996, and replace with serviceable parts.

(d) Report findings of cracked fan hubs in accordance with Accomplishment Instructions, Paragraph F, of Attachment 1 to PW ASB No. A6272, dated September 24, 1996, within 48 hours after inspection to Robert Guyotte, Manager, Engine Certification Branch, Engine Certification Office, FAA, Engine and Propeller Directorate, 12 New England Executive Park, Burlington, MA 01803-5299; telephone (617) 238-7142, fax (617) 238-7199; Internet: Robert.Guyotte@faa.dot.gov. Reporting requirements have been approved by the Office of Management and Budget and assigned OMB control number 2120-0056.

(e) An alternative method of compliance or adjustment of the compliance time that provides an acceptable level of safety may be

used if approved by the Manager, Engine Certification Office. The request should be forwarded through an appropriate FAA Principal Maintenance Inspector, who may add comments and then send it to the Manager, Engine Certification Office.

Note 2: Information concerning the existence of approved alternative methods of compliance with this airworthiness directive, if any, may be obtained from the Engine Certification Office.

(f) Special flight permits may be issued in accordance with sections 21.197 and 21.199 of the Federal Aviation regulations (14 CFR 21.197 and 21.199) to operate the aircraft to a location where the requirements of this AD can be accomplished.

(g) The actions required by this AD shall be done in accordance with the following PW ASB:

Document No.	Pages	Revision	Date
A6212	1-21	original	September 24, 1996.
NDIP-892	1-30	A	September 15, 1996.
Attachment I	AI-1-AI-4	A	September 15, 1996.

Total pages: 55.

This incorporation by reference was approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from Pratt & Whitney, 400 Main St., East Hartford, CT 06108; telephone (860) 565-6600, fax (860) 565-4503. Copies may be inspected at the FAA, New England Region, Office of the Assistant Chief Counsel, 12 New England Executive Park, Burlington, MA; or at the Office of the Federal Register, 800 North Capitol Street NW., Suite 700, Washington, DC.

(h) This amendment becomes effective on March 5, 1997.

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Jay J. Pardee,

Manager, Engine and Propeller Directorate, Aircraft Certification Service.

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