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## **DEPARTMENT OF TRANSPORTATION**

### **Federal Aviation Administration**

#### **14 CFR Part 39**

**[Docket No. FAA-2020-0442; Project Identifier AD-2020-00260-E; Amendment 39-21640; AD 2021-14-13]**

**RIN 2120-AA64**

#### **Airworthiness Directives; Pratt & Whitney Turbofan Engines**

**AGENCY:** Federal Aviation Administration (FAA), DOT.

**ACTION:** Final rule.

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**SUMMARY:** The FAA is adopting a new airworthiness directive (AD) for all Pratt & Whitney (PW) PW2037, PW2037M, PW2040, and F117-PW-100 model turbofan engines. This AD was prompted by a report of an uncontained engine failure resulting from cracks in the knife edge of the high-pressure turbine (HPT) 2nd-stage air seal assembly. This AD requires fluorescent penetrant inspections (FPIs) and visual inspections of the HPT 2nd-stage air seal assembly and, depending on the results of the inspections, replacement of the HPT 2nd-stage air seal assembly with a part eligible for installation. This AD also requires replacement of the affected HPT 2nd-stage air seal assembly, depending on the engine model, at either the next engine shop visit or the next piece-part opportunity. The FAA is issuing this AD to address the unsafe condition on these products.

**DATES:** This AD is effective September 1, 2021.

**ADDRESSES:** For service information identified in this final rule, contact Pratt & Whitney, 400 Main Street, East Hartford, CT 06118; phone: (800) 565-0140; fax: (860) 565-5442; email: help24@pw.utc.com; website: <https://fleetcare.pw.utc.com>. You may view this service information at the FAA, Airworthiness Products Section, Operational Safety Branch, 1200 District Avenue, Burlington, MA 01803. For information on the availability of this material at the FAA, call (781) 238-7759. It is also available at <https://www.regulations.gov> by searching for and locating Docket No. FAA-2020-0442.

#### **Examining the AD Docket**

You may examine the AD docket at <https://www.regulations.gov> by searching for and locating Docket No. FAA-2020-0442; or in person at Docket Operations between 9 a.m. and 5 p.m., Monday through Friday, except Federal holidays. The AD docket contains this final rule, any comments

received, and other information. The address for Docket Operations is U.S. Department of Transportation, Docket Operations, M-30, West Building Ground Floor, Room W12-140, 1200 New Jersey Avenue SE, Washington, DC 20590.

**FOR FURTHER INFORMATION CONTACT:** Carol Nguyen, Aviation Safety Engineer, ECO Branch, FAA, 1200 District Avenue, Burlington, MA 01803; phone: (781) 238-7655; fax: (781) 238-7199; email: carol.nguyen@faa.gov.

## **SUPPLEMENTARY INFORMATION:**

### **Background**

The FAA issued a notice of proposed rulemaking (NPRM) to amend 14 CFR part 39 by adding an AD that would apply to all PW PW2037, PW2037M, PW2040, and F117-PW-100 model turbofan engines. The NPRM published in the Federal Register on June 1, 2020 (85 FR 33043). The NPRM was prompted by a report of an uncontained engine failure resulting from cracks in the knife edge of the HPT 2nd-stage air seal assembly. After further analysis, it was determined that the knife-edge crack was due to seal rubbing that elevated the HPT 2nd-stage air seal assembly temperature and induced fatigue. In the NPRM, the FAA proposed to require initial and repetitive borescope inspections (BSIs), FPIs, and visual inspections of the HPT 2nd-stage air seal assembly and, depending on the results of the inspections, replacement of the HPT 2nd-stage air seal assembly with a part eligible for installation. The NPRM also proposed to require replacement of the affected HPT 2nd-stage air seal assembly, depending on the engine model, at either the next engine shop visit or the next piece-part opportunity. The FAA is issuing this AD to address the unsafe condition on these products.

### **Discussion of Final Airworthiness Directive**

#### **Comments**

The FAA received comments from six commenters. The commenters were the Air Line Pilots Association, International (ALPA); Delta Air Lines, Inc. (Delta); FedEx Express (FedEx); MTU Maintenance Hannover GmbH (MTU); The Boeing Company (Boeing); and United Airlines (UAL).

The following presents the comments received on the NPRM and the FAA's response to each comment.

#### **Requests To Revise Proposed BSI Requirement**

Delta, MTU, and FedEx requested revisions to the BSI proposed in the NPRM. The FAA details the comments to the BSI in the following paragraphs but is not providing an individual response to each comment given that the FAA removed the proposal for BSI from this AD.

#### **Request To Increase the Compliance Time for Initial BSI To Allow Sufficient Time To Complete Inspector Training**

Delta requested that the compliance time of 500 FCs after the effective date of this AD for the initial BSI proposed by paragraph (g)(1)(i) of the NPRM be extended to account for the difference in predicted flight utilization versus actual utilization as a result of the COVID-19 pandemic. Delta cited concerns that the 500 FC compliance time will not allow sufficient time for training inspectors to obtain qualifications to perform the BSI proposed by paragraph (g)(1)(i) of the NPRM. Delta noted that government restrictions and recommendations on travel and class size for in-person on-site

training plus the lack of remote training opportunities represent obstacles to adequately training inspectors.

### **Request To Update Repetitive BSI Language**

Delta requested that the FAA update paragraph (g)(1)(ii) of the NPRM from “. . . perform the BSI required by paragraph (g)(1)(i) of this AD within every 500 FCs since performance of the last BSI” to “. . . perform the BSI required by paragraph (g)(1)(i) of this AD within every 500 FCs since performance of the last BSI that was done per paragraph (g)(1)(i) or (g)(1)(ii) of this AD.” Delta reasoned that the phrase “last BSI” of paragraph (g)(1)(ii) of the NPRM could cause confusion since the “last BSI” is the “initial BSI.”

### **Request To Clarify “Before Further Flight”**

Delta requested that the FAA update paragraph (g)(1)(iii) of the NPRM to clarify the phrase “before further flight.” Delta asked whether the action is to remove the engine before the flight of the aircraft, or remove the HPT 2nd-stage air seal assembly and perform the inspections proposed by paragraph (g)(2) of the NPRM before flight of the engine. Delta stated there could be confusion that the aircraft is prohibited from further flight until the HPT 2nd-stage air seal assembly is removed from the engine.

### **Request To Include a Scenario When To Perform the BSI**

Delta and MTU requested confirmation that the FAA included all the non-modulated turbine cooling air (TCA) system engines population into the proposed BSI requirement. MTU requested that the FAA update paragraph (g)(1) of the NPRM to include engines that have deactivated/mechanically disconnected the TCA system.

### **Request To Update the Costs of Compliance and Work Hours**

FedEx requested that the hours to perform the BSI of the HPT 2nd-stage air seal assembly be changed to 4.8 hours. FedEx cited PW Service Bulletin (SB) PW2000 72-773, dated March 11, 2020 (PW SB PW2000 72-773), that indicates that the on-wing inspection takes 4.8 hours and not 2 work hours as indicated in the NPRM.

### **Request To Update the Terminating Action**

FedEx requested that the FAA revise paragraph (h), Terminating Action, of the NPRM from “. . . terminating action for the repetitive BSI requirements in paragraph (g)(1)(ii) of this AD” to “. . . terminating action for the initial BSI requirement in paragraph (g)(1)(i) and the repetitive BSI requirements in paragraph (g)(1)(ii) of this AD.” FedEx reasoned that an HPT 2nd-stage air seal assembly could be removed for a reason unrelated to this AD and inducted for an engine shop visit before the HPT 2nd-stage air seal assembly is subject to the initial BSI proposed by paragraph (g)(1)(i) of the NPRM. As written in the NPRM, FedEx suggested it could be interpreted that the HPT 2nd-stage air seal assembly would still need an initial inspection within 2,500 FCs after this unrelated engine shop visit.

### **Request To Clarify Revision of NDIP-1217**

Delta requested clarification if this AD allows for any revision level of Non-Destructive Inspection Procedure, Technique Sheet for Detection of Cracking in the PW2000 HPT 2nd Stage

Airseal by Borescope Inspection Method (NDIP-1217). Delta cited paragraph (g)(1)(i) of the NPRM that proposed to require PW SB PW2000 72-773, which references NDIP-1217.

### **Request To Clarify Reporting**

Delta requested clarification if paragraph (g)(1)(i) of the NPRM proposed to require reporting of the inspection results to PW Materials & Processes Engineering/Non-Destructive Evaluation Engineer. Delta noted that paragraph (g)(1)(i) of the NPRM references paragraph 6 of PW SB PW2000 72-773, which references NDIP-1217, which specifies reporting of the inspection results.

### **Request To Approve Tooling Equivalent**

Delta requested that their rotator be approved as a tooling equivalent for performing the BSI proposed by paragraph (g)(1) of the NPRM. Delta reasoned that they worked in conjunction with PW to approve a tooling equivalent and requested confirmation that PW has the authority to approve tooling equivalents and that an alternative method of compliance request would not be required.

Delta also requested approval to deviate from paragraph 6.1.2 of NDIP-1217 to remove the starter rather than the crank pad to use their rotator.

### **Request To Allow HPT Rotating by Hand for BSI**

Delta requested that the FAA allow the performance of the BSI of the HPT 2nd-stage air seal assembly proposed by paragraph (g)(1) of the NPRM to be rotated by hand rather than by a motor-driven unit per paragraph 6 of NDIP-1217. Delta reasoned the motor-driven unit may not be available at all stations and a second maintenance technician can rotate the HPT rotor manually, which allows the inspector to use two hands for the BSI.

### **Request To Confirm Affected Engine Serial Numbers**

Delta commented that “EagleNet case (CAS-83493-C0M6W0)” was submitted to P&W to confirm RTC engines cannot be converted to CET/pre-CET engines or vice versa. Delta requested that the FAA confirm that the list of affected engine serial numbers in the proposed AD is an adequate method for controlling risk of affected population.

### **Comment on Operational and Economic Costs**

FedEx commented that the proposed rule would impact approximately half of its fleet of PW2000 model turbofan engines. The inspection program itself will have a minor operational impact as it can be incorporated into an existing hot section inspection program, but unplanned engine changes will result in local operational impact. FedEx noted that the cost of the on-wing inspection program [BSI] would be minimal but the cost of engines that need to be removed immediately will have a fairly significant impact. FedEx noted that these operational and economic impacts are acceptable when weighed against the impact of an in-service event.

### **FAA Response to Comments To Revise the BSI Inspection**

The FAA determined the need to remove the proposed BSI requirement from this AD based on comments regarding accessibility of inspector training. The FAA may consider additional rulemaking and will consider these comments in the development of any additional requirements.

## **Request That Individual Part Serviceability Not Depend on the Inspection Results of Other Parts**

Delta commented that individual part serviceability should not depend on the inspection results of other parts. Delta also commented that if inspections are not possible which would allow the mating HPT 1st-stage disk or the HPT 2nd-stage hub to be deemed serviceable, independent from inspection status of the HPT 2nd-stage air seal assembly, then the manufacturer should revise the engine manuals to clarify that the mating HPT 1st-stage disk or HPT 2nd-stage hub cannot be made serviceable unless an inspection of the HPT 2nd-stage air seal assembly indicates it is free of cracks. Delta stated that this would remove the possibility that the mating HPT 1st-stage disk or HPT 2nd-stage hub would be made serviceable and then installed in an engine before the HPT 2nd-stage air seal assembly is inspected.

The FAA did not revise this AD in response to this comment. A crack, as identified in the shaded regions of Figure 1 to paragraph (g)(1)(iii) of this AD (Figure 1), which extends towards the knife-edge region of the HPT 2nd-stage air seal assembly, impacts the serviceability of the mating HPT 1st-stage disk and the HPT 2nd-stage hub. A crack identified in the shaded region of Figure 1 of this AD of the HPT 2nd-stage air seal assembly results in the requirement to remove the HPT 2nd-stage air seal assembly, mating HPT 1st-stage disk, and HPT 2nd-stage hub.

## **Request To Remove Inspections for Parts Being Scrapped**

Delta requested that the FAA update paragraph (g)(2)(i) of the NPRM (paragraph (g)(1)(i) of this AD) to remove the visual inspection, knife-edge coating strip, and FPI of the HPT 2nd-stage air seal assembly if the HPT 2nd-stage air seal assembly, mating HPT 1st-stage disk, and HPT 2nd-stage hub are being scrapped. Further, Delta requested if the HPT 2nd-stage air seal assembly is planned to be scrapped, then the mating HPT 1st-stage disk and HPT 2nd-stage hub be allowed to be made serviceable without FPI of the HPT 2nd-stage air seal assembly.

The FAA disagrees with the need to change the AD based on this comment. If the HPT 2nd-stage air seal assembly, HPT 1st-stage disk, and HPT 2nd-stage hub are removed from service, then the inspections required by paragraph (g)(1)(i) of this AD are not applicable. The inspections are required only if the operator returns the parts to service.

FPI is the only way to ensure the HPT 2nd-stage air seal assembly is free from cracks because an FPI will reveal cracks not detected by a visual inspection. The serviceability of the both the HPT 1st-stage disk and HPT 2nd-stage hub is directly dependent on the HPT 2nd-stage air seal assembly. If an operator does not FPI the HPT 2nd-stage air seal assembly, then neither the HPT 1st-stage disk nor HPT 2nd-stage disk can be returned to service. The FAA did not change this AD.

## **Request To Reference Engine Manual for Inspection Instructions**

FedEx requested that the FAA update paragraph (g)(2)(i) of the NPRM (paragraph (g)(1)(i) of this AD) to reference Chapter 72-52-60, Inspection/Check-01, of the PW2000 Series Engine Manual for instructions to perform the visual inspection, knife-edge coating removal, and FPI of the HPT 2nd-stage air seal assembly.

The FAA determined it is not necessary to require use of specific service information as the visual inspection and FPI required by paragraph (g)(1)(i) of this AD are routine inspections that may vary between operators. The FAA, however, revised paragraph (g)(1)(i) of this AD to refer to Chapter 72-52-60, Repair-01, of the PW2000 Series Engine Manual for guidance on striping the knife edge coating from the HPT 2nd-stage air seal assembly.

## **Request To Remove FPI**

Delta requested that paragraph (g)(2)(ii) of the NPRM (paragraph (g)(1)(ii) of this AD) remove the proposed requirement to perform an FPI and require only visual inspections of the HPT 2nd-stage air seal assembly. Delta reasoned that based on NDIP-1217, cracks are detectable by visual inspection, thereby making FPI unnecessary. Delta concluded that performing only the visual inspection enables the HPT 2nd-stage air seal assembly to be inspected at initial disassembly while still in the presence of the mating HPT 1st-stage disk and HPT 2nd-stage hub, which simplifies determining if parts need to be scrapped if a crack is found. Otherwise, Delta stated that paragraph (g)(1)(iii) of the NPRM creates a logistical challenge for performing inspections as the HPT 2nd-stage air seal assembly, mating HPT 1st-stage disk, and HPT 2nd-stage hub could be routed to different locations with different lead times.

The FAA disagrees. While cracks may be detected by visual inspection, an FPI will reveal cracks not detected by visual inspection. Additionally, the FPI is required to confirm that the HPT 2nd-stage air seal assembly is free of cracks. The FAA did not change this AD.

## **Request To Allow Repair of the HPT 2nd-Stage Air Seal Assembly**

Delta and MTU requested that paragraph (g)(2)(ii) of the NPRM (paragraph (g)(1)(ii) of this AD) be updated to allow repair of the HPT 2nd-stage air seal assembly if a crack is found. The commenters reasoned that Chapter 72-52-60, Inspection/Check-01 and Repair-02, of the PW2000 Series Engine Manual provides information for repairing a cracked HPT 2nd-stage air seal assembly. The commenters concluded that this AD should allow repair; otherwise, Chapter 72-52-60 of the PW2000 Series Engine Manual should be deleted or updated.

The FAA disagrees that the crack repairs identified in the engine manual should be incorporated in this AD. If a crack is found during the inspections required by this AD for the HPT 2nd-stage air seal assembly, the part must be removed from service and cannot be repaired. The FAA disagrees that Chapter 72-52-60 of the PW2000 Series Engine Manual should be deleted or updated. This repair is specifically for mechanical damage such as handling damage and foreign object damage in the knife edge area. This repair is not applicable to cracks identified by this AD. The damage addressed is unrelated and the repair does not need to be prohibited. The requirements contained in this AD take precedence over any contrary provisions in the manufacturer's instructions for continued airworthiness. The FAA did not update this AD.

## **Request To Clarify Removal From Service**

Delta requested that the FAA clarify paragraph (g)(2)(ii) of the NPRM (paragraph (g)(1)(ii) of this AD) that states the HPT 2nd-stage air seal assembly must be removed from service if a crack is found. Delta asked if the HPT 2nd-stage air seal assembly must be scrapped, or if the HPT 2nd-stage air seal assembly can be repaired and returned to service after re-identifying it with a new P/N. Delta added that the engine manual provides a repair option of knife-edge cracks caused by mechanical damage.

The FAA notes that “remove from service” in this AD indicates that the HPT 2nd-stage air seal assembly should be permanently removed from service if a crack is found. Any cracked HPT 2nd-stage air seal assembly cannot be repaired and returned to service per the requirements of this AD.

## **Request To Remove “Before Further Flight”**

FedEx requested that the FAA remove the phrase “before further flight” from paragraphs (g)(2)(ii) and (iii) of the NPRM (paragraphs (g)(1)(ii) and (iii) of this AD). FedEx reasoned that since the visual inspection, knife edge coating removal, and FPI are performed at every piece-part opportunity of the mating HPT 1st-stage disk, HPT 2nd-stage disk, or the HPT 2nd-stage air seal

assembly, “before further flight” is redundant. Additionally, FedEx stated that the overhaul facility must comply with the engine manual inspection criteria and would have no other option but to make the HPT 2nd-stage air seal assembly permanently unserviceable.

The FAA agrees and removed “before further flight” from paragraphs (g)(1)(ii) and (iii) of this AD.

### **Request To Clarify Part Replacement After Crack Is Found**

MTU requested clarification regarding whether the mating HPT 1st-stage disk or HPT 2nd-stage hub needs to be replaced if a crack is found after performing the inspections proposed by paragraph (g)(2)(iii) of the NPRM (paragraph (g)(1)(iii) of this AD), or if both the mating HPT 1st-stage disk and HPT 2nd-stage hub need to be replaced.

If a crack is found as identified in the shaded region of Figure 1 to paragraph (g)(1)(iii) of this AD (Figure 1) that extends toward the knife-edge region of the HPT 2nd-stage air seal assembly, this AD requires replacement of the HPT 2nd-stage air seal assembly, mating HPT 1st-stage disk, and HPT 2nd-stage hub.

### **Request To Clarify Terminating Action**

UAL requested clarification if paragraph (h), Terminating Action, of the NPRM applies to the visual inspection and FPI of the HPT 2nd-stage air seal assembly proposed by paragraph (g)(2) of the NPRM (paragraph (g)(1) of this AD).

The FAA notes that there is no terminating action to the visual inspection and FPI of the HPT 2nd-stage air seal assembly required by paragraph (g)(1) of this AD. The visual inspection and FPI required by paragraph (g)(1) of this AD are required for all HPT 2nd-stage air seal assemblies, including P/Ns others than 1A8209 or 1A8209-001. As stated in an earlier response, with the removal of the BSI requirements from this AD, the FAA removed the terminating action from this AD.

### **Request To Clarify Applicability for Visual Inspection and FPI**

UAL requested clarification of whether paragraph (g)(1) of this AD applies if an HPT 2nd-stage air seal assembly, with a P/N other than P/N 1A8209 or 1A8209-001, is installed.

Delta requested that an applicability statement referencing P/Ns for affected HPT 2nd-stage air seal assemblies be added to paragraph (g)(2) of the NPRM. Paragraph (g)(2) of the NPRM proposed to require a visual inspection of the HPT 2nd-stage air seal assembly, stripping the knife edge coating from the HPT 2nd-stage air seal assembly, and then performing an FPI of the HPT 2nd-stage air seal assembly. Delta noted that if an HPT 2nd-stage air seal assembly has been modified and re-identified with a new P/N using PW SB PW2000 72-754, Revision No. 2, dated April 30, 2019, then it should not be subject to the same inspections as HPT 2nd-stage air seal assembly, P/N 1A8209 or 1A8209-001.

The FAA disagrees and notes that the visual inspection and the FPI required by paragraph (g)(1)(i) of this AD are required for all HPT 2nd-stage air seal assemblies, regardless of the P/N. The FAA did not update this AD.

### **Request To Allow Installation of Mating Parts Without Past HPT 2nd-Stage Air Seal Assembly Inspection Verification**

Delta requested that a mating HPT 1st-stage disk and HPT 2nd-stage hub made serviceable before the effective date of this AD be eligible for installation without verification that all past HPT 2nd-stage air seal assemblies had visual inspections and FPI to verify no cracks were found. Delta reasoned that the inspections were not previously required and adequate records may not exist.

Additionally, Delta stated it might not be possible to re-inspect all previous HPT 2nd-stage air seal assemblies for cracks as some may have been scrapped before the inspection.

The FAA notes that an HPT 1st-stage disk and HPT 2nd-stage hub made serviceable before the effective date of this AD are not subject to the requirements of (g)(1)(iii) of the AD until their next piece part exposure. The FAA did not update this AD.

### **Request To Clarify the Location of the Forward and Aft Edges**

Delta and MTU requested that the FAA clarify the location of the forward and aft edges of the HPT 2nd-stage air seal assembly. Delta asked if the forward edge is the barrel section forward of the #1 knife-edge or any part that extends beyond the barrel section.

The FAA removed references to “forward edge” and “aft edge” of the HPT 2nd-stage air seal assembly from this AD. In their place, the FAA added Figure 1 to paragraph (g)(1)(iii) of this AD to specify the locations of the HPT 2nd-stage air seal assembly that require inspection for cracks.

### **Request To Clarify the Definition of Through-Crack**

Delta and FedEx requested that the FAA clarify the definition of “through-crack.” Delta asked if a “through-crack” is a crack going through the axial direction or radial direction of the HPT 2nd-stage air seal assembly. Delta referenced Figure 5 of NDIP-1217 that appears to show a through-crack in the axial direction. Delta inferred from paragraph (i)(4) of the NPRM that a through-crack is in the radial direction. Delta requested a diagram to help illustrate what constitutes a through-crack.

FedEx stated that a lenticular seal is a two-piece component that becomes an inseparable assembly during manufacturing. As a result, it would be impossible to distinguish a through-crack from a surface crack over a large area of the HPT 2nd-stage air seal assembly's exterior since its interior surfaces are inaccessible. FedEx cited Chapter 72-52-60, Inspection/Check-01, Figures 801 and 801A, of the PW2000 Series Engine Manual, which highlights areas where through-thickness cracks are critical. According to FedEx, however, these images fail to address the ability to determine whether a surface crack is a “through-crack.” Additionally, the PW2000 Series Engine Manual does not provide dimensions that bound the areas making HPT disk replacement subjective.

The FAA agrees that it is difficult to differentiate between a surface crack and through-crack; therefore, the FAA removed references to “through-crack” from this AD. The FAA notes that any crack, in any direction, found in the HPT 2nd-stage air seal assembly, requires removal of the HPT 2nd-stage air seal assembly from service. As stated in an earlier response, the FAA added Figure 1 to show the locations of the HPT 2nd-stage air seal assembly that require inspection for cracks. However, the FAA is not providing dimensions that bind the areas. If the inspections of the HPT 2nd-stage air seal assembly reveal a crack in the shaded regions of Figure 1, which extends towards the knife-edge region, the HPT 2nd-stage air seal assembly must be removed from service.

### **Request To Clarify Engine Shop Visit**

Delta requested that the FAA clarify the definition of “engine shop visit” related to which engine flanges the FAA considers “major mating engine flanges.” Delta requested that the FAA exclude the low-pressure compressor (LPC) module flange as a major mating engine flange because LPC module life limited parts (LLPs) can be swapped while the engine is installed on the aircraft. Delta reasoned that the separation of the LPC module flange should not require replacement of the HPT 2nd-stage air seal assembly. These LPC swaps may extend time between engine shop visits if the LLPs are located in the LPC.

The FAA determined the need to revise the definition of “engine shop visit” by replacing separation of “major mating engine flanges” with separation of the “N or M engine flange.” If the LPC swap does not involve separating the N or M engine flange, then the compliance time for replacing the HPT 2nd-stage air seal assembly has not occurred as required by this AD.



## **Request To Update the Definition of Piece-Part Opportunity**

Delta requested that the FAA update the definition of “piece-part opportunity” from “when the part is completely disassembled” to “any time the seal is removed from the HPT module.” Delta reasoned that while the HPT 2nd-stage air seal assembly is referred to as an “assembly,” the HPT 2nd-stage air seal assembly cannot be dissembled.

The FAA partially agrees and updated the definition to clarify what constitutes “piece-part opportunity” for the HPT 1st-stage disk, HPT 2nd-stage hub, and HPT 2nd-stage air seal assembly.

## **Request To Update the Definition of Part Eligible for Installation**

Delta requested that the FAA update the definition of “part eligible for installation” to remove paragraph (i)(3)(ii) and to refer only to “An HPT 2nd-stage air seal assembly that is not P/N 1A8209 or 1A8209-001.” Delta reasoned that paragraph (i)(3)(ii) of the NPRM, which states that an HPT 2nd-stage air seal assembly that has been modified using the service information is eligible for installation, is unnecessary because the HPT 2nd-stage air seal assembly receives a new P/N, which is not P/N 1A8209 or 1A8209-001, after repair.

The FAA agrees and revised the definition of an HPT 2nd-stage air seal assembly that is eligible for installation, now in paragraph (h)(3) of this AD, to refer to an HPT 2nd-stage air seal assembly with a P/N other than 1A8209 or 1A8209-001.

## **Request To Update Service Information Revision**

MTU requested that the FAA reference PW SB PW2000 72-754, Revision No. 3, dated August 14, 2019, in this AD instead of Revision No. 2, dated April 30, 2019.

The FAA agrees. The FAA updated PW SB PW2000 72-754 to Revision No. 3, dated August 14, 2019, throughout this AD.

## **Request To Update the Service Information Description**

MTU requested that the FAA update the service information description in the Other Related Service Information paragraph of the NPRM (Related Service Information of this AD) to include the replacement and modification of the HPT 2nd-stage air seal assembly.

The FAA agrees. The FAA updated the service information description in the Related Service Information paragraph in this AD.

## **Request To Update the Costs of Compliance**

UAL requested that the Costs of Compliance include additional costs such as delays in engine builds and modifications. UAL reasoned that piece-part modification of the HPT 2nd-stage air seal assembly, mating HPT 1st-stage disk, and HPT 2nd-stage hub are independent of each other. Scraping all parts proposed by paragraph (g)(2)(iii) of the NPRM (paragraph (g)(1)(iii) of this AD) will force engine centers to delay routing the mating HPT 1st-stage disk and HPT 2nd-stage hub for modification until the HPT 2nd-stage air seal assembly is inspected, thus delaying an engine build or incurring costs while the mating HPT 1st-stage disk and HPT 2nd-stage hub are partially or fully scrapped.

The FAA disagrees with updating the costs of compliance. The cost analysis in AD rulemaking actions typically includes only the costs associated with complying with the AD and does not include secondary costs. The FAA's cost estimate includes the work hours and parts costs to perform the required actions.

## No Comments on This AD

ALPA supported the AD and appreciated the opportunity to comment. Boeing had no comments.

## Conclusion

The FAA reviewed the relevant data, considered any comments received, and determined that air safety requires adopting this AD as proposed. Accordingly, the FAA is issuing this AD to address the unsafe condition on these products. Except for minor editorial changes, and any other changes described previously, this AD is adopted as proposed in the NPRM. None of the changes will increase the economic burden on any operator.

## Related Service Information

The FAA reviewed PW SB PW2000 72-754, Revision No. 3, dated August 14, 2019, and PW SB PWF117 72-402, Revision No. 2, dated May 3, 2019. The SBs describe procedures for replacing or modifying the HPT 2nd-stage air seal assembly.

## Interim Action

The FAA considers this AD to be an interim action. The FAA may consider additional rulemaking based on further investigation of the unsafe condition.

## Costs of Compliance

The FAA estimates that this AD affects 445 engines installed on airplanes of U.S. registry. The FAA estimates the following costs to comply with this AD:

### Estimated Costs

Action	Labor cost	Parts cost	Cost per product	Cost on U.S. operators
Visually inspect, strip the knife edge coating, and FPI the HPT 2nd-stage air seal assembly	10 work-hours × \$85 per hour = \$850	\$0	\$850	\$378,250

The FAA estimates the following costs to do any necessary replacements. The FAA has no way of determining how many replacements of the HPT 2nd-stage air seal assembly will be done with a modified HPT 2nd-stage air seal assembly and how many will be done with a new HPT 2nd-stage air seal assembly. The FAA also has no way of determining the number of engines that might need replacement of the HPT 2nd-stage air seal assembly, HPT 1st-stage disk, and HPT 2nd-stage hub.

### On-Condition Costs

Action	Labor cost	Parts cost	Cost per product
Replace the HPT 2nd-stage air seal assembly with modified HPT 2nd-stage air seal assembly	10 work-hours × \$85 per hour = \$850	\$5,000	\$5,850

Replace the HPT 2nd-stage air seal assembly with new seal assembly	0.25 work-hours × \$85 per hour = \$21.25	355,000	355,021.25
Replace the HPT 2nd-stage air seal assembly, HPT 1st-stage disk, and HPT 2nd-stage hub (based on FPI results)	0.25 work-hours × \$85 per hour = \$21.25	970,000	970,021.25

### Authority for This Rulemaking

Title 49 of the United States Code specifies the FAA's authority to issue rules on aviation safety. Subtitle I, section 106, describes the authority of the FAA Administrator. Subtitle VII: Aviation Programs, describes in more detail the scope of the Agency's authority.

The FAA is issuing this rulemaking under the authority described in Subtitle VII, Part A, Subpart III, Section 44701: General requirements. Under that section, Congress charges the FAA with promoting safe flight of civil aircraft in air commerce by prescribing regulations for practices, methods, and procedures the Administrator finds necessary for safety in air commerce. This regulation is within the scope of that authority because it addresses an unsafe condition that is likely to exist or develop on products identified in this rulemaking action.

### Regulatory Findings

This AD will not have federalism implications under Executive Order 13132. This AD will not have a substantial direct effect 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.

For the reasons discussed above, I certify that this AD:

- (1) Is not a “significant regulatory action” under Executive Order 12866,
- (2) Will not affect intrastate aviation in Alaska, 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.

### List of Subjects in 14 CFR Part 39

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

### The Amendment

Accordingly, under the authority delegated to me by the Administrator, the FAA amends 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.

#### **§ 39.13 [Amended]**

2. The FAA amends § 39.13 by adding the following new airworthiness directive:



**2021-14-13 Pratt & Whitney:** Amendment 39-21640; Docket No. FAA-2020-0442; Project Identifier AD-2020-00260-E.

**(a) Effective Date**

This airworthiness directive (AD) is effective September 1, 2021.

**(b) Affected ADs**

None.

**(c) Applicability**

This AD applies to all Pratt & Whitney (PW) PW2037, PW2037M, PW2040, and F117-PW-100 model turbofan engines.

**(d) Subject**

Joint Aircraft System Component (JASC) Code 7250, Turbine Section.

**(e) Unsafe Condition**

This AD was prompted by a report of an uncontained engine failure resulting from cracks originating in the knife edge of the high-pressure turbine (HPT) 2nd-stage air seal assembly. The FAA is issuing this AD to prevent failure of the HPT 2nd-stage air seal assembly. The unsafe condition, if not addressed, could result in uncontained HPT 2nd-stage air seal assembly release, damage to the engine, and damage to the airplane.

**(f) Compliance**

Comply with this AD within the compliance times specified, unless already done.

**(g) Required Actions**

**(1) Visual Inspection and Fluorescent Penetrant Inspection (FPI) of HPT 2nd-Stage Air Seal Assembly**

After the effective date of this AD, at every piece-part opportunity of the HPT 1st-stage disk, HPT 2nd-stage hub, or the HPT 2nd-stage air seal assembly:

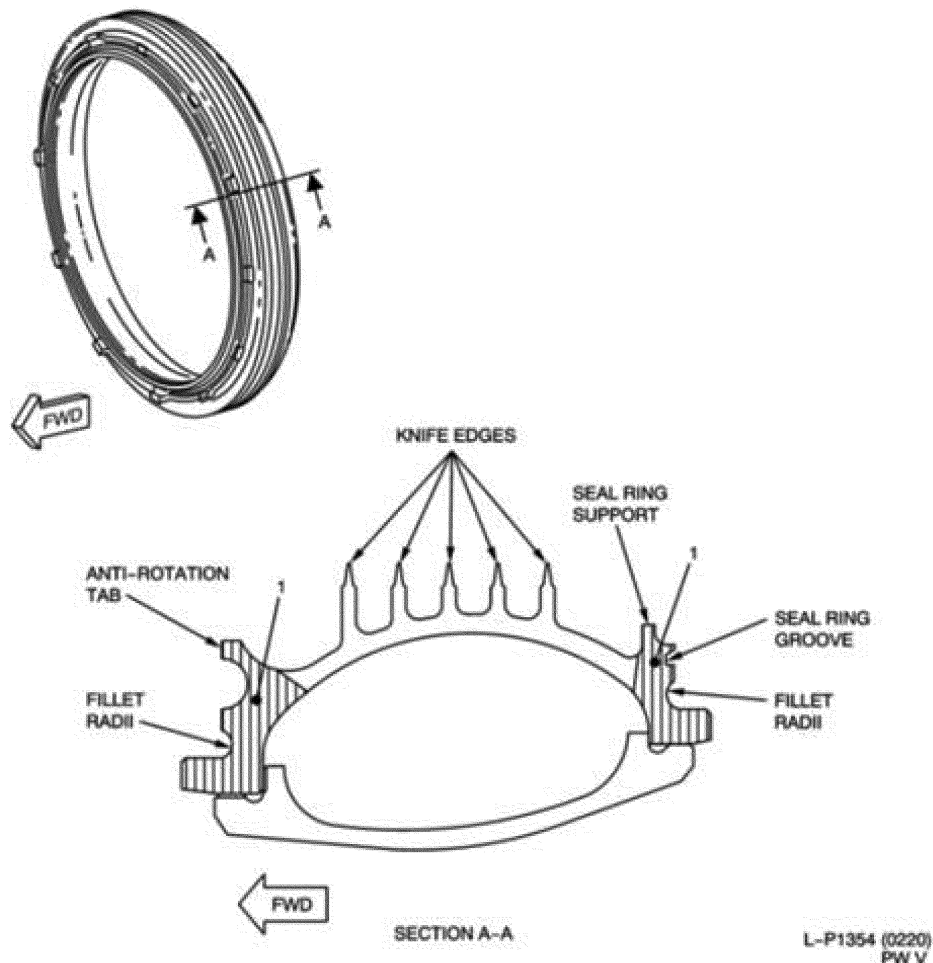
(i) Perform a visual inspection of the HPT 2nd-stage air seal assembly, strip the knife edge coating from the HPT 2nd-stage air seal assembly, and then perform an FPI of the HPT 2nd-stage air seal assembly.

Note 1 to paragraph (g)(1)(i): Guidance on stripping the knife edge coating from the HPT 2nd-stage air seal assembly required by paragraph (g)(1)(i) of this AD can be found Chapter 72-52-60, Repair-01, of the PW2000 Series Engine Manual.

(ii) If a crack is found in the HPT 2nd-stage air seal assembly during the visual inspection or FPI required by paragraph (g)(1)(i) of this AD, remove the HPT 2nd-stage air seal assembly from service and replace it with a part eligible for installation.

(iii) During the visual inspection or FPI required by paragraph (g)(1)(i) of this AD, if a crack is found in the shaded regions of the HPT 2nd-stage air seal assembly identified in Figure 1 to paragraph (g)(1)(iii) of this AD (Figure 1), which extends towards the knife-edge region of the HPT 2nd-stage air seal assembly, remove the HPT 2nd-stage air seal assembly, mating HPT 1st-stage disk, and HPT 2nd-stage hub from service, and replace the parts with parts eligible for installation. In order to return the mating HPT 1st-stage disk and HPT 2nd-stage hub to service, the inspections of the HPT 2nd-stage air seal assembly cannot reveal a crack identified in the shaded regions of Figure 1, which extends towards the knife-edge region.

**Figure 1 to Paragraph (g)(1)(iii) – Crack Inspection Critical Areas**



## (2) Replacement of HPT 2nd-Stage Air Seal Assembly

(i) For PW PW2037, PW2037M, and PW2040 model turbofan engines, at the next engine shop visit after the effective date of this AD, remove the HPT 2nd-stage air seal assembly, part number (P/N) 1A8209 or 1A8209-001, and replace it with a part eligible for installation.

(ii) For PW F117-PW-100 model turbofan engines, at the next piece part opportunity after the effective date of this AD, remove the HPT 2nd-stage air seal assembly, P/N 1A8209 or 1A8209-001, and replace it with a part eligible for installation.

**(h) Definitions**

(1) For the purpose of this AD, an “engine shop visit” is the induction of an engine into the shop for maintenance involving the separation of the N or M engine flange. The separation of engine flanges solely for the purposes of transportation of the engine without subsequent engine maintenance does not constitute an engine shop visit.

(2) For the purpose of this AD, a “piece-part opportunity” is:

(i) For the HPT 1st-stage disk, when the disk is removed from the engine and all the blades are removed;

(ii) For the HPT 2nd-stage hub, when the hub is removed from the engine and all the blades are removed; or

(iii) For the HPT 2nd-stage air seal assembly, when the assembly is removed from either the HPT 1st-stage disk or the HPT 2nd-stage hub.

(3) For the purpose of this AD, a “part eligible for installation” is an HPT 2nd-stage air seal assembly with a P/N other than 1A8209 or 1A8209-001.

**(i) Alternative Methods of Compliance (AMOCs)**

(1) The Manager, ECO Branch, FAA, has the authority to approve AMOCs for this AD, if requested using the procedures found in 14 CFR 39.19. In accordance with 14 CFR 39.19, send your request to your principal inspector or local Flight Standards District Office, as appropriate. If sending information directly to the manager of the certification office, send it to the attention of the person identified in Related Information. You may email your request to: ANE-AD-AMOC@faa.gov.

(2) Before using any approved AMOC, notify your appropriate principal inspector, or lacking a principal inspector, the manager of the local flight standards district office/certificate holding district office.

**(j) Related Information**

For more information about this AD, contact Carol Nguyen, Aviation Safety Engineer, ECO Branch, FAA, 1200 District Avenue, Burlington, MA 01803; phone: (781) 238-7655; fax: (781) 238-7199; email: carol.nguyen@faa.gov.

**(k) Material Incorporated by Reference**

None.

Issued on June 30, 2021.

Ross Landes,  
Deputy Director for Regulatory Operations, Compliance & Airworthiness Division, Aircraft Certification Service.

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