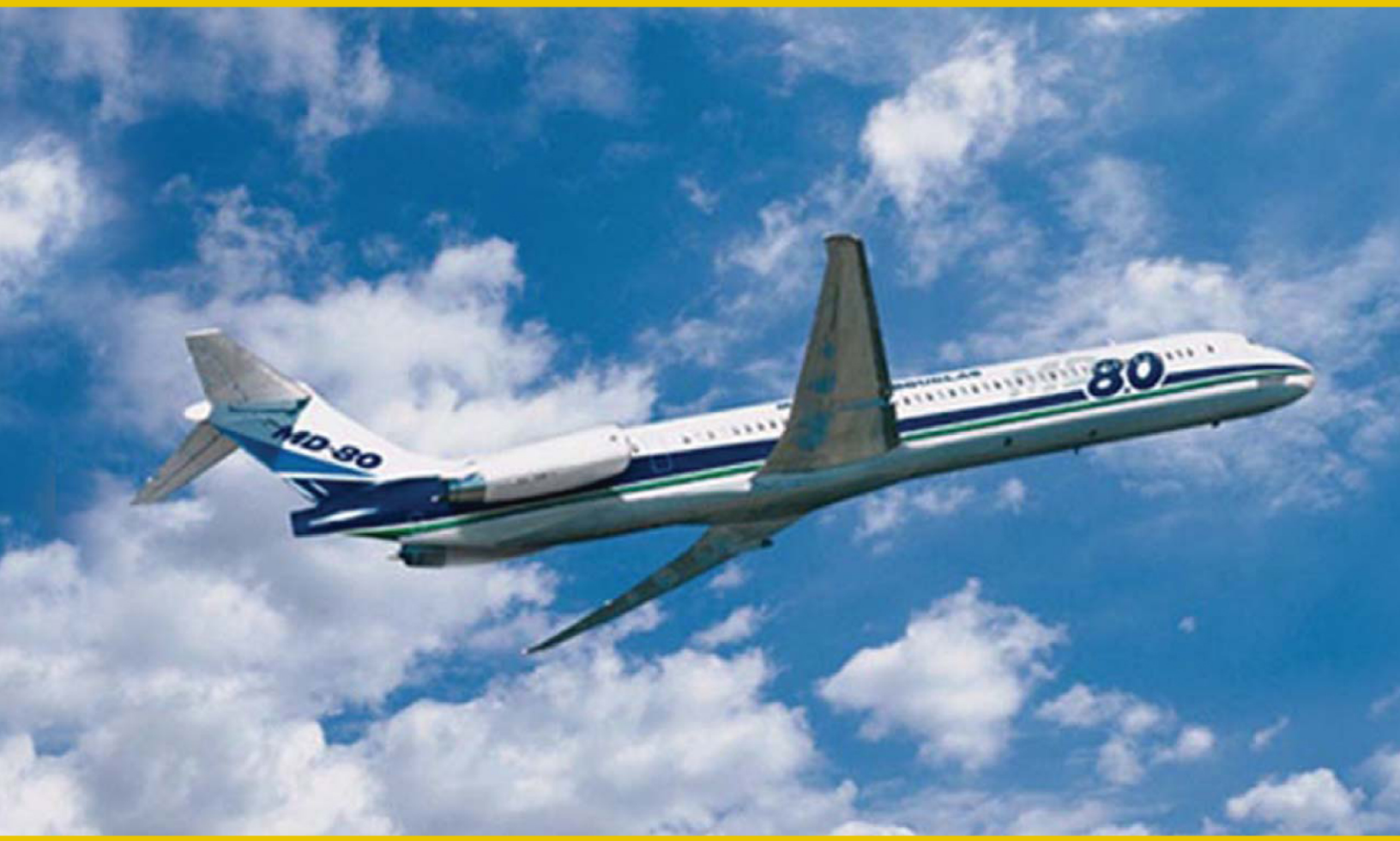
Federal Aviation Administration

Report to U.S. Transportation Secretary Mary E. Peters on American Airlines MD-80 Groundings

May 2, 2008



EXECUTIVE SUMMARY

This is the Federal Aviation Administration's response to a request by US Transportation Secretary Mary E. Peters to document events leading up to, during and after the grounding of the MD 80 fleet of 367 aircraft by American Airlines on April 8, 2008, resulting in the cancellation of thousands of flights and tremendous inconvenience for hundreds of thousands of airline passengers.

American Airlines grounded its MD80 fleet after being informed by FAA inspectors from the Southwest Region Flight Standards Division that inspections had revealed 16 aircraft were not in compliance with FAA AD 2006-15-15, which relates to clamping, bundling and sheathing of electrical wiring that surrounds the auxiliary hydraulic pump in the MD 80 aircraft. These findings were made during an audit conducted to verify airline compliance with various airworthiness directives. During the first phase of the audit – March 13 to March 28 – inspectors found aircraft at American that were not in compliance with AD-2006 15-15 and American grounded some aircraft and advised the FAA it would take corrective action. On April 8, as part of Phase II of the audit, FAA inspectors intended to verify that American had completed the corrective action and found, instead, aircraft in noncompliance.

Prior to this audit, there was no requirement for the FAA to inspect the aircraft for this AD. The deadline for AD compliance was March 5, and it is the responsibility of the carrier to effectively perform the work as outlined in the AD. The carrier's maintenance plan is audited regularly and American certified that the work had been done. American never applied for an Alternate Means of Compliance (AMOC)–a well-established procedure known throughout industry–or indicated they were having difficultly complying with the specific AD.

This report details the timeline of FAA actions related to inspection of American Airlines aircraft as part of a special emphasis audit, the audit results at American, subsequent activities including the finding of non-compliance by the FAA and the grounding of the fleet by American. Also, as directed by Secretary Peters, the report contains a look at what, if anything, could have been done differently, and what can be done in the future to try to eliminate a similar circumstance while still maintaining the highest aircraft safety standards in the world.

Overall Findings

- American Airlines did not perform adequate or sufficient work in response to AD 2006 -15-15 on its MD-80 fleet. The workmanship accomplished in response to this AD was unacceptable.
- Materials used to take the required corrective action were other than specified.
- The safety goal of the AD was not accomplished because the risk of chaffing, arcing and sparking -- the very elements targeted by the AD -- were not sufficiently addressed.

- American Airlines created an Engineering Change Order (ECO) to guide their mechanics in accomplishing the work of AD. There may have been confusion in the directives of the ECO that were in conflict with the AD.

In summary, American failed to take opportunities available before March 5, 2008, to inspect, repair, and accomplish the AD, as required. As with any AD, the FAA established a compliance "threshold," based on an engineering assessment of when action should be taken to detect or prevent the unsafe condition. The 18 months allowed in the AD was the time period deemed acceptable to accomplish the corrective actions, based on a risk analysis. This AD was designed to prevent ignition or possible fire or explosion near a fuel tank. While such an explosion is a "low probability" event, if it occurs, it has high consequences, according to the risk analysis. American, because of its large MD-80 fleet, had worked with Boeing in the development of the associated service bulletins (SB) and was aware of the needed corrective actions **three and a half years before the end of the compliance period in March 2008**. If American had properly accomplished the AD by the March deadline, or again on March 25-26 when problems were identified, the April grounding would not have been necessary.

There was never any type of agreement—formal or informal—between the FAA and American Airlines to let the aircraft in question operate past the deadline established in the AD, as suggested by the Wall Street Journal article dated May 2. There is no "informal" path to operating in non-compliance with AD's–the airline must demonstrate compliance.

Background

Often safety measures are developed as a result of lessons learned from major accidents or tragedies. The regulatory mission of the FAA encompasses learning from the past to proactively intervene in the potential issues of the future. Following the TWA 800 accident over Long Island in 1996, FAA and industry undertook a detailed analysis to determine potential ignition sources that may lead to a fuel tank explosion. Boeing identified wire bundles in the wheel well of the MD-80, which pass in close proximity to the fuel tank and where fuel vapors may be present, as creating a potential risk. To address this risk, Boeing developed specific service bulletins**.**

After the Swissair 111 accident in September 1998 involving an MD-11, both the FAA and industry learned a great deal about wiring and the related safety issues. In January 1999, the National Transportation Safety Board issued a recommendation addressing the inspection and examination of wiring on MD-11 airplanes. The examinations were for loose wire connections, inconsistent wire routings, broken bonding wires, small wire bend radii, and chafed and cracked wire insulation. The inspections revealed chafed and cut wires; damaged, cracked, or chafed wires; and inconsistencies in the routing of wires and wire bundles.

These findings, following the TWA 800 accident, added even more urgency to the elimination of possible ignition sources near fuel tanks.

Boeing issued SB MD 80-29A070 in August 2004 and revised that SB in July 2005 as a result of reports from operators involving three instances of electrically shorted wires in the right wheel well and evidence of arcing on the auxiliary hydraulic pump power cables. One incident resulted in a fire in the wheel well. Investigation revealed damage to the power cables caused by structural chafing. Analysis also determined the need for extra protection on the harness where it came in close proximity to the center fuel tank. If not corrected, there is a possibility of electrical arcing and/or shorted wires which could result in a wheel well fire and/or hazard to the adjacent fuel tank.

As a result, the FAA began to review Boeing SBs associated with arcing and sparking and reassessed safety concerns including SB MD 80-29A070. We determined that the issue addressed in the SB was critical and warranted an AD. AD 2006 15-15, issued in July 2006 required a one-time general visual inspection for chafing, or signs of arcing, of the wire bundle for the auxiliary hydraulic pump and required completion of all applicable corrective actions before further flight after the inspection. The corrective actions included:

- Installation of protective sleeving on the auxiliary hydraulic pump wire harness.
- Correction of the routing and clamping of the auxiliary hydraulic pump wire harness and airfoil ice protection system overheat sensor connector wire.
- Replacement of an existing connector "backshell" with a 90-degree version.
- Adding snap tubing on a portion of the wire harness.

All of these interventions were tailored to secure the wire bundle in place, eliminate risk of chafing and sparking, and keep the wires out of close proximity to other moving parts to eliminate risk of interference.

The compliance time was set at 18 months from the effective date of the AD, which was September 5, 2006. The 18-month compliance period is based on the manufacturer's assessment of potential risk occurring as a result of any chafing or misrouted wire bundles. That 18-month period to comply ended on March 5, 2008.

The stated purpose of the AD was:

> To prevent shorted wires or arcing at the auxiliary hydraulic pump, which could result in loss of auxiliary hydraulic power, or a fire in the wheel well of the airplane; and to reduce the potential of an ignition source adjacent to the fuel tanks, which, in combination with flammable fuel vapors, could result in a fuel tank explosion and consequent loss of the airplane.

As the industry's largest MD-80 operator, American was aware of the AD's requirements **years** in advance of the AD's actual issuance as the company worked with Boeing on SB MD80-29A070. This AD first addressed the wire harness issue. Subsequently, American issued internal maintenance directives known as Engineering Change Orders

(ECO). An ECO is American's means of taking an SB or AD, among other things, and converting it into the work instructions for their aircraft maintenance technicians. The ECO also ensures and documents compliance. Boeing issued a revision to the SB, and American revised its ECOs accordingly, even before the FAA issued the actual AD on September 5, 2006.

Following the issuance of AD 2006-15-15, compliance with the corrective actions in the SB became mandatory, and all operators had 18 months to comply with the requirements of the AD. From the time American worked with Boeing on the original SBs, **American had well over three and a half years to inspect and reconfigure fully**, as necessary, its MD-80 fleet. If for any reason during the 18 months American found it couldn't comply or had a different solution for compliance, it could have requested an Alternative Methods of Compliance (AMOC) for the AD, a process available to any airline.

Timeline of Inspections and Groundings

On March 13, 2008, the Director of the Flight Standards Service issued Notice 8900.36, Special Emphasis Validation of Airworthiness Directives Oversight. This notice provided instructions for completing a two-phase special emphasis inspection to validate the FAA's oversight of air carrier compliance with ADs. Phase I instructed aviation safety inspectors (ASI) with oversight responsibility for Title 14 Code of Federal Regulations (14 CFR) part 121 air carriers to identify ten ADs for each aircraft fleet operated by the air carrier. In addition, they were to inspect the appropriate paperwork, for at least one aircraft for each of the ADs selected, to determine whether the air carrier had complied with the AD. Then, they were to perform a visual inspection of the aircraft, at their discretion, to verify the air carrier's compliance with the AD. Inspectors completed Phase I on March 28, 2008.

AD 2006-15-15, which affected 5 U.S. airlines (including American) and 535 MD-80 series aircraft, was one of the 10 ADs selected for the Phase I compliance review for operators with MD-80 fleets. American operates the bulk of the MD-80 fleet with 367 aircraft.

On March 25 - 26, 2008, FAA inspectors notified American that they had concerns with American's compliance with AD 2006-15-15 on ten aircraft being worked on at American's maintenance base in Tulsa, Oklahoma. In all four areas highlighted in the Boeing SB, inspectors found instances of incorrect use of nylon tie wraps, incorrect installations of snap tubes, incorrect securing of clamps, clamps not installed at all, no or improper or no wrappings installed, and more importantly, instances of chafing between wire bundles and other surfaces. These were serious and unacceptable failures. In some cases, clamps were loose with the potential to dislodge, becoming free-floating projectiles. American chose to immediately ground a portion of its MD-80 fleet. As a result of FAA's findings, the airline purportedly re-inspected its entire MD-80 fleet—supposedly identifying and repairing all aircraft not in compliance. (See attachment 1 for depictions of these problems and what a correct repair should look like.)

Based upon the results of American's fleet wide inspection, American requested, and was granted, an AMOC by the Los Angeles Aircraft Certification Office (ACO). American's AMOC surprisingly only requested approval to use an alternative type of safety wire and no other modifications to the requirements of the AD. Because of the limited AMOC request, and American's assurances that each aircraft returned to service would comply with the AD, the revelations of the subsequent inspections were totally unexpected.

About two weeks later, beginning on **Monday, April 7, and into Tuesday, April 8, 2008**, FAA inspectors examined 17 aircraft at DFW International Airport to determine if American was in compliance with the AD and AMOC. Sixteen of 17 MD-80 aircraft inspected were found to be in noncompliance with the AD. The FAA immediately communicated these findings to American. Based upon the FAA inspections, neither compliance nor airworthiness of American's MD-80 fleet could be assured in the opinion of the FAA. (See attachment 2 for examples of the types of issues inspectors found.) American agreed that, based upon these FAA findings, compliance could no longer be assumed, and American chose to cease operating its entire MD-80 fleet because the aircraft were not in compliance with the requirements of AD 2006-15-15.

Beginning on the evening of **April 8 through the morning of April 9, 2008**, the Los Angeles ACO, Boeing, American, Southwest Region Flight Standards Division, and the AMR Certificate Management Office held teleconferences to address American's request for an additional AMOC. Boeing and American proposed to address immediately only six items in the AD that they deemed to affect "safety-of-flight." Under this scenario, American would be allowed to continue to operate an additional 60 days in order to come into full compliance with the AD.

The principal avionics and maintenance inspectors **did not support an extension of time** to allow the carrier to attain full compliance with the AD because of safety-of-flight concerns. The photographs in attachment 2 are representative of the discrepancies found with American's MD-80s. At this point, American had failed to demonstrate its ability to comply with the AD on several occasions, resulting in FAA's decision to inspect 100% of the aircraft before they were returned to service. Had the AMOC been issued, and in order to provide the necessary level of assurance, FAA inspectors would have had to inspect each aircraft twice, once after the six safety-of-flight items were addressed and again after the additional requirements of the AD were met. A time extension without FAA inspection of each aircraft would have assumed that American would properly accomplish the six safety-of-flight items—an assumption not justified by American's previous failures to perform the work properly.

<u>Why was the magnitude so great?</u>

The magnitude of the groundings, specifically beginning April 8, 2008, was due to the fact that MD-80 aircraft account for nearly 50 percent of American's total number of aircraft, constituting well over 40 percent of its daily flights. The time required for American to return the MD-80s to service was, however, solely within its control. Depending upon the configuration of the aircraft, Boeing estimated that it would take as

little as 2 hours to complete the AD to as much as 12.5 hours per aircraft. The FAA had inspectors available throughout the country to review aircraft as they completed their inspections and repairs. This was the result of constant coordination between the FAA and the airline.

As the American maintenance crews completed the work on an aircraft, certifying that it was fully compliant with the AD, an FAA inspector reviewed the work in accordance with the AD, as well as general aircraft airworthiness requirements. These inspections were limited to the area affected by the AD.

From April 8 - 12, 2008, American presented 351 aircraft to FAA inspectors, who initially found 207 aircraft not compliant with the AD. This represents a 70 percent failure rate. Each of these 207 aircraft required additional work before being accepted as in compliance and returned to service.

During this time period, there were instances where FAA inspectors waited for hours for an aircraft to be ready for inspection. Also, onsite reports from inspectors included instances of parts shortages, as well as American personnel shortages, that were needed to inspect or repair aircraft. By April 12, 2008, all aircraft were found to be in compliance with AD 2006-15-15.

Conclusion

While it may be argued that any *one* of the discrepancies -- or non-compliance issues -- may not pose an immediate safety risk, the aggregate findings of the workmanship quality raised the specter of a cumulative safety risk. Left uncorrected, the workmanship errors would have increased the odds that one or more of American's large MD-80 fleet would have experienced arcing, smoke, or fire–problems that have caused serious incidents and fatal accidents in the past.

Despite the alleged ambiguity of the wiring AD, other carriers flying MD-80 models did not have significant problems complying with its provisions. But it also is fair to say that while American experienced issues responding to this particular airworthiness directive, there is no reason to suspect the overall quality of American's maintenance program. During the audit FAA reviewed 59 additional airworthiness directives and American was able to demonstrate compliance. In addition, FAA regularly performs surveillance of American's maintenance program.

The American situation reinforces the need for the FAA to review the AD process, and even more important, for air carriers to follow ADs precisely. Carriers also must adhere to the provisions of the Enhanced Airworthiness program for Airplane Systems (EAPAS) rule, the premise of which is that wiring systems must be properly designed, installed and maintained to avoid catastrophic results.

In answer to the question "What could have been done to prevent the extreme impact to the flying public," American Airlines could have done the work properly in the allotted

time or applied for a comprehensive AMOC earlier in the process and also resolved discrepancies involving safety of flight (e.g., chafing).

Follow-up Actions

The FAA has formed a joint industry/Government task force to review the AD process, starting with AD 2006-15-15. The task force will look into how the affected airlines developed the mechanics' work instructions and how the airlines could have managed this AD better, as well as FAA's process for developing this specific AD. After completing that effort, the task force will look at the overall FAA process for developing ADs, how we communicate critical AD information to operators, and what, if any, procedures need to be changed to improve this process.

We will also increase our efforts on training and educating the industry regarding the importance of wiring in light of our SFAR 88 (Fuel Tank Safety), Aging Aircraft, and Enhanced Airworthiness Programs for Aircraft Systems (EAPAS) rules.

American Airlines intends to create a process to prototype its work on an AD on one aircraft and have the work reviewed by FAA inspectors. Two other airlines have already begun a similar process.

As steward of the nation's aviation system, it is incumbent on the FAA to ensure the safety and efficiency of the system for the flying public. This situation with American Airlines that caused so much stress and disorder to the public was truly regrettable. We pledge, Madame Secretary, to continue to improve our oversight, reporting and communication with all in our industry, so the system can maximize efficiency with no cost to safety.

Federal Aviation Administration

Timeline of Events Leading to American Airlines MD-80 Groundings

July 17, 1996

TWA 800, a Boeing 747-100, explodes off Long Island from ignition of fuel vapors caused by an ignition source in the center fuel tank.

September 2, 1998

Swissair 111, a McDonnell Douglas MD-11, crashes into the ocean off Halifax, Nova Scotia from an onboard fire caused by faulty wiring from an entertainment system.

July 2005

Boeing revises Service Bulletin MD-80-29A070 which addresses wiring in the right wheel well.

July 31, 2006

The FAA issues Airworthiness Directive 2006-15-15 which requires compliance in 18 months.

March 5, 2008

Compliance deadline: All operators are required to comply with AD 2006-15-15.

March 19, 2008

Phase 1 of the FAA's review of airline AD compliance starts.

March 25-26, 2008

FAA inspectors note discrepancies in American Airlines' execution of AD 2006-15-15 and notify the airline of their concerns.

March 26-27, 2008

American grounds part of its MD-80 fleet and cancels hundreds of flights. After reinspecting the aircraft, the airline assures the FAA they are in compliance. The FAA issues a limited Alternate Means of Compliance (AMOC) resolving compliance issues.

April 7, 2008

As Part of the FAA's Phase 2 audits, FAA inspectors reexamine a number of American MD-80, finding almost all are still non-compliant with the AD. The FAA notifies the airline.

April 8-11, 2008

American acknowledges the apparent non-compliance and grounds its entire MD-80 until the AD requirements are satisfied. Thousands of flights are cancelled.

April 12, 2008

The FAA finds all American MD-80s are in compliance, and the airline returns all the aircraft to service.