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## Uncontained engine failure, McDonnell Douglas MD-82, November 23, 1996

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**Micro-summary:** This McDonnell Douglas MD-82 experienced an uncontained engine failure on takeoff.

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**Event Date:** 1996-11-23 at 1622 CST


**Investigative Body:** National Transportation Safety Board (NTSB), USA


**Investigative Body's Web Site:** <http://www.nts.gov/>

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  2. Readers are advised that each report is a glimpse of events at specific points in time. While broad themes permeate the causal events leading up to crashes, and we can learn from those, the specific regulatory and technological environments can and do change. ***Your company's flight operations manual is the final authority as to the safe operation of your aircraft!***
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|  |  |                                 |                                  |                                      |                  |
|--|--|---------------------------------|----------------------------------|--------------------------------------|------------------|
|    |  | NTSB ID: FTW97IA045             |                                  | Aircraft Registration Number: N3507A |                  |
|  |  | Occurrence Date: 11/23/1996     |                                  | Most Critical Injury: Minor          |                  |
|  |  | Occurrence Type: Incident       |                                  | Investigated By: NTSB                |                  |
| Location/Time  |  |                                 |                                  |                                      |                  |
| Nearest City/Place<br>DFW AIRPORT  |  | State<br>TX                     | Zip Code<br>75261                | Local Time<br>1622                   | Time Zone<br>CST |
| Airport Proximity: On Airport  |  | Distance From Landing Facility: |                                  | Direction From Airport:              |                  |
| Aircraft Information Summary   |  |                                 |                                  |                                      |                  |
| Aircraft Manufacturer<br>McDonnell Douglas   |  | Model/Series<br>MD-82           |                                  | Type of Aircraft<br>Airplane         |                  |
| Sightseeing Flight: No   |  |                                 | Air Medical Transport Flight: No |                                      |                  |
| Narrative  |  |                                 |                                  |                                      |                  |
| Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:   |  |                                 |                                  |                                      |                  |
| <p>HISTORY OF FLIGHT</p> <p>On November 23, 1996, at 1622 central standard time, an MD-82, N3507A, sustained an uncontained engine failure during takeoff roll at DFW Airport, Texas. The 2 pilots, 3 flight attendants, and 111 passengers were not injured; however, 3 passengers sustained minor injuries during the emergency evacuation of the airplane. The airplane was being operated by American Airlines as flight 1447 under Title 14 CFR Part 121. Visual meteorological conditions prevailed for the scheduled international passenger flight which was originating at the time of the incident. An IFR flight plan had been filed with Acapulco, Mexico, as the intended destination.</p> <p>According to the captain, the airplane was departing on runway 17R when "on takeoff roll (approximately 120 knots), a thump was felt with a slight left nose pull." The onboard flight data recorder indicated that the pilots aborted the takeoff at 124.5 knots (V1 was 132 knots). The pilots taxied clear of the runway and came to a stop on taxiway L3. The flight attendants in the cabin area reported that there was "smoke and smoke odor" in the cabin. Several flight crews on the ground at DFW airport reported on the tower frequency that the incident airplane's left engine was on fire. The captain stated that, after he received these radio communications (about his left engine being on fire), he initiated evacuation of the airplane.</p> <p>The flight attendants reported that the captain told them not to use the left aft emergency exit. The rear tail cone was deployed, the rear stairs were lowered, and a flight attendant estimated that approximately 40 to 60 individuals used them for evacuation. Another flight attendant reported that smoke was observed outside of the right over wing exits and she "commanded that the right window exits be blocked." She further reported that the left over wing exits were used to evacuate approximately 30 to 40 individuals. The third flight attendant deployed the left forward slide and she estimated that approximately 50 individuals evacuated through that exit.</p> <p>A witness reported that "it took the fire equipment approximately 4 minutes to arrive at the airplane." The Airport Rescue and Fire Fighting (ARFF) personnel reported that the engine fire was confined to the tailpipe area and was extinguished in approximately 2 minutes.</p> |  |                                 |                                  |                                      |                  |
| INJURIES TO PERSONS  |  |                                 |                                  |                                      |                  |
| <p>After the evacuation was completed, three women requested medical assistance. Two of the women received treatment by paramedics and then continued their trip. The third woman was taken to a local hospital for x-rays and she continued her trip that evening.</p>  |  |                                 |                                  |                                      |                  |
| DAMAGE TO AIRPLANE   |  |                                 |                                  |                                      |                  |
| <p>Examination of the airplane revealed that all the turbine blade airfoils had separated from their</p>   |  |                                 |                                  |                                      |                  |

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|  <p>National Transportation Safety Board<br/><b>FACTUAL REPORT</b><br/>AVIATION</p> | NTSB ID: FTW97IA045         |
|  | Occurrence Date: 11/23/1996 |
|  | Occurrence Type: Incident   |

## Narrative (Continued)

roots in the number 3 and 4 turbine disks, and the engine case had one 12 inch by 3 inch hole in it on the inboard side of the turbine section. The cowling was punctured, the lower side of the engine pylon had sustained "impact damage," and the unpressurized empennage area had two puncture holes each approximately one quarter inch square.

The left engine was removed from the airplane and shipped to American Airlines Maintenance and Engineering Center in Tulsa, Oklahoma for disassembly and examination. The teardown examination of the engine revealed that the Low Pressure Turbine (LPT) shaft was deformed and fractured into two pieces. The adjacent 17 inch long High Pressure Turbine (HPT) center tube was found twisted and broken into several pieces. Extensive coke deposits were identified on both the outer diameter of the LPT shaft, and the front and aft ends of the inner diameter of the center tube. The designed clearance between the LPT shaft and the center tube is 93 mils; shaft variations due to vibrations and maneuvering loads will utilize 30 to 40 mils of that space (see the enclosed Powerplant Group Chairman's Report for details of the examination which was accomplished on December 4, 1996).

## AIRCRAFT INFORMATION

The aircraft was built in 1989 and had two Pratt & Whitney JT8D-217C axial flow jet engines (21,000 pounds of thrust each) mounted on the empennage. The left engine had accrued a total of 25,072 hours of time, and the last major overhaul was performed 6,407 hours before the incident. Aircraft records indicated that the engine had no abnormal oil usage nor any unusual vibrations reported prior to the failure.

## TESTS AND RESEARCH


The NTSB Materials Laboratory examined the two pieces of the LPT shaft. According to the Materials Laboratory Report, the broken ends of the shaft were twisted and subjected to "considerable" permanent deformation. The amount of plastic deformation was indicative of exposure to high temperatures. The surfaces of the shaft adjacent to the fracture were dark blue to black and soot deposits were present. The fracture surface was also discolored dark blue (see the attached NTSB Metallurgist Group Chairman Report for details).


Pratt & Whitney requested that parts from the engine be sent to their facility in East Hartford, Connecticut, for further evaluation (see attached letter). Their staff did identify an anomaly; the HPT shaft was found with a (one of three) 4 1/2 bearing stack retention pin missing. Coke deposits were found inside and around the missing pin hole.

## ADDITIONAL DATA

Subsequent to this event, Pratt & Whitney initiated and is still involved (as this report is being written) in a study of the coke depositional processes, i.e., the temperature range, the oil particle size, and depositional surface characteristics. The project completion date is proposed for the end of 1998. Pratt & Whitney is also designing and testing a double-walled HPT center tube which engineers believe will reduce the coking on the LPT shaft.

The airplane was released to an American Airlines representative on November 24, 1996; the engine parts that were analyzed by Pratt & Whitney were released to American Airlines on November 17, 1997.

|  |                         |                                      |                                |                      |              |
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| <br><b>National Transportation Safety Board</b><br><b>FACTUAL REPORT</b><br><b>AVIATION</b> |                         | NTSB ID: FTW97IA045                  |                                |                      |              |
|  |                         | Occurrence Date: 11/23/1996          |                                |                      |              |
|  |                         | Occurrence Type: Incident            |                                |                      |              |
| <b>Landing Facility/Approach Information</b>   |                         |                                      |                                |                      |              |
| Airport Name   | Airport ID:             | Airport Elevation                    | Runway Used                    | Runway Length        | Runway Width |
| DALLAS-FORT WORTH INTL   | DFW                     | 603 Ft. MSL                          | 17R                            | 13400                | 200          |
| Runway Surface Type: Concrete  |                         |                                      |                                |                      |              |
| Runway Surface Condition: Dry  |                         |                                      |                                |                      |              |
| Type Instrument Approach: NONE   |                         |                                      |                                |                      |              |
| VFR Approach/Landing: None   |                         |                                      |                                |                      |              |
| <b>Aircraft Information</b>  |                         |                                      |                                |                      |              |
| Aircraft Manufacturer  |                         | Model/Series                         |                                | Serial Number        |              |
| McDonnell Douglas  |                         | MD-82                                |                                | 49801                |              |
| Airworthiness Certificate(s): Normal   |                         |                                      |                                |                      |              |
| Landing Gear Type: Retractable - Tricycle  |                         |                                      |                                |                      |              |
| Homebuilt Aircraft? No   | Number of Seats: 121    | Certified Max Gross Wt.              | 140000 LBS                     | Number of Engines: 2 |              |
| Engine Type:   | Engine Manufacturer:    | Model/Series:                        | Rated Power:                   |                      |              |
| Turbo Jet  | P&W                     | JT8D-217C                            | 21000 LBS                      |                      |              |
| - Aircraft Inspection Information  |                         |                                      |                                |                      |              |
| Type of Last Inspection  | Date of Last Inspection | Time Since Last Inspection           | Airframe Total Time            |                      |              |
| Continuous Airworthiness   | 11/1996                 | 24 Hours                             | 20780 Hours                    |                      |              |
| - Emergency Locator Transmitter (ELT) Information  |                         |                                      |                                |                      |              |
| ELT Installed? No  | ELT Operated?           | ELT Aided in Locating Accident Site? |                                |                      |              |
| <b>Owner/Operator Information</b>  |                         |                                      |                                |                      |              |
| Registered Aircraft Owner  |                         | Street Address                       |                                |                      |              |
| WILMINGTON TRUST CORP  |                         | RODNEY SQUARE NORTH                  |                                |                      |              |
|  |                         | City                                 | State                          | Zip Code             |              |
|  |                         | WILMINGTON                           | DL                             | 19890                |              |
| Operator of Aircraft   |                         | Street Address                       |                                |                      |              |
| AMERICAN AIRLINES  |                         | 4333 AMON CARTER BLVD                |                                |                      |              |
|  |                         | City                                 | State                          | Zip Code             |              |
|  |                         | FT. WORTH                            | TX                             | 76155                |              |
| Operator Does Business As:   |                         |                                      | Operator Designator Code: AALA |                      |              |
| - Type of U.S. Certificate(s) Held:  |                         |                                      |                                |                      |              |
| Air Carrier Operating Certificate(s): Flag Carrier/Domestic  |                         |                                      |                                |                      |              |
| Operating Certificate:   |                         |                                      | Operator Certificate:          |                      |              |
| Regulation Flight Conducted Under: Part 121: Air Carrier   |                         |                                      |                                |                      |              |
| Type of Flight Operation Conducted: Scheduled; International; Passenger Only   |                         |                                      |                                |                      |              |

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|  <p><b>National Transportation Safety Board</b><br/><b>FACTUAL REPORT</b><br/><b>AVIATION</b></p> | NTSB ID: FTW971A045         |
|  | Occurrence Date: 11/23/1996 |
|  | Occurrence Type: Incident   |

**First Pilot Information**

|                 |                 |                  |                          |           |
|-----------------|-----------------|------------------|--------------------------|-----------|
| Name<br>On File | City<br>On File | State<br>On File | Date of Birth<br>On File | Age<br>42 |
|-----------------|-----------------|------------------|--------------------------|-----------|

|        |                     |                                      |                             |
|--------|---------------------|--------------------------------------|-----------------------------|
| Sex: M | Seat Occupied: Left | Principal Profession: Civilian Pilot | Certificate Number: On File |
|--------|---------------------|--------------------------------------|-----------------------------|

Certificate(s): Airline Transport

Airplane Rating(s): Multi-engine Land; Single-engine Land

Rotorcraft/Glider/LTA: None

Instrument Rating(s): Airplane

Instructor Rating(s): None

|   |                                 |
|---|---------------------------------|
| Type Rating/Endorsement for Accident/Incident Aircraft? Yes | Current Biennial Flight Review? |
|---|---------------------------------|

|                        |  |                                    |
|------------------------|--|------------------------------------|
| Medical Cert.: Class 1 | Medical Cert. Status: Valid Medical--no waivers/lim. | Date of Last Medical Exam: 07/1996 |
|------------------------|--|------------------------------------|

| - Flight Time Matrix  | All A/C | This Make and Model | Airplane Single Engine | Airplane Multi-Engine | Night | Instrument |           | Rotorcraft | Glider | Lighter Than Air |
|-----------------------|---------|---------------------|------------------------|-----------------------|-------|------------|-----------|------------|--------|------------------|
|                       |         |                     |                        |                       |       | Actual     | Simulated |            |        |                  |
| Total Time            | 10901   | 5901                |                        |                       |       |            |           |            |        |                  |
| Pilot In Command(PIC) |         |                     |                        |                       |       |            |           |            |        |                  |
| Instructor            |         |                     |                        |                       |       |            |           |            |        |                  |
| Last 90 Days          |         |                     |                        |                       |       |            |           |            |        |                  |
| Last 30 Days          |         |                     |                        |                       |       |            |           |            |        |                  |
| Last 24 Hours         |         |                     |                        |                       |       |            |           |            |        |                  |

|                    |                            |                          |                   |
|--------------------|----------------------------|--------------------------|-------------------|
| Seatbelt Used? Yes | Shoulder Harness Used? Yes | Toxicology Performed? No | Second Pilot? Yes |
|--------------------|----------------------------|--------------------------|-------------------|

**Flight Plan/Itinerary**

Type of Flight Plan Filed: IFR

|   |       |                           |                        |                  |
|---|-------|---------------------------|------------------------|------------------|
| Departure Point<br>Same as Accident/Incident Location | State | Airport Identifier<br>DFW | Departure Time<br>1619 | Time Zone<br>CST |
|---|-------|---------------------------|------------------------|------------------|

|                         |             |                           |  |
|-------------------------|-------------|---------------------------|--|
| Destination<br>ACAPULCO | State<br>MX | Airport Identifier<br>ACP |  |
|-------------------------|-------------|---------------------------|--|


Type of Clearance: IFR

Type of Airspace: Class B

**Weather Information**

Source of Briefing:  
Company

Method of Briefing:

|  |                             |
|--|-----------------------------|
|  <p><b>National Transportation Safety Board</b><br/><b>FACTUAL REPORT</b><br/><b>AVIATION</b></p> | NTSB ID: FTW971A045         |
|  | Occurrence Date: 11/23/1996 |
|  | Occurrence Type: Incident   |

|                                       |                       |  |               |                                 |                              |
|---------------------------------------|-----------------------|--|---------------|---------------------------------|------------------------------|
| <b>Weather Information</b>            |                       |  |               |                                 |                              |
| WOF ID                                | Observation Time      | Time Zone  | WOF Elevation | WOF Distance From Accident Site | Direction From Accident Site |
| DFW                                   | 1604                  | CST  | 603 Ft. MSL   | 1 NM                            | 270 Deg. Mag.                |
| Sky/Lowest Cloud Condition: Scattered |                       |  | 700 Ft. AGL   | Condition of Light: Day         |                              |
| Lowest Ceiling: Broken                |                       | 5500 Ft. AGL   |               | Visibility: 5 SM                | Altimeter: 29.00 "Hg         |
| Temperature: 19 °C                    | Dew Point: 17 °C      | Wind Direction: 160                                    |               | Density Altitude: Ft.           |                              |
| Wind Speed: 10                        | Gusts:                | Weather Conditions at Accident Site: Visual Conditions |               |                                 |                              |
| Visibility (RVR): 0 Ft.               | Visibility (RVV) 0 SM | Intensity of Precipitation: Light                      |               |                                 |                              |
| Restrictions to Visibility: None      |                       |  |               |                                 |                              |
| Type of Precipitation: Drizzle        |                       |  |               |                                 |                              |

|                             |                       |                          |
|-----------------------------|-----------------------|--------------------------|
| <b>Accident Information</b> |                       |                          |
| Aircraft Damage: Minor      | Aircraft Fire: Ground | Aircraft Explosion: None |

|   |       |         |       |      |       |
|---|-------|---------|-------|------|-------|
| Classification: U.S. Registered/U.S. Soil |       |         |       |      |       |
| <b>- Injury Summary Matrix</b>            | Fatal | Serious | Minor | None | TOTAL |
| First Pilot                               |       |         |       | 1    | 1     |
| Second Pilot                              |       |         |       | 1    | 1     |
| Student Pilot                             |       |         |       |      |       |
| Flight Instructor                         |       |         |       |      |       |
| Check Pilot                               |       |         |       |      |       |
| Flight Engineer                           |       |         |       |      |       |
| Cabin Attendants                          |       |         |       | 3    | 3     |
| Other Crew                                |       |         |       |      |       |
| Passengers                                |       |         | 3     | 111  | 114   |
| - TOTAL ABOARD -                          |       |         | 3     | 116  | 119   |
| Other Ground                              | 0     | 0       | 0     |      | 0     |
| - GRAND TOTAL -                           | 0     | 0       | 3     | 116  | 119   |

National Transportation Safety Board

**FACTUAL REPORT**

**AVIATION**



NTSB ID: FTW971A045

Occurrence Date: 11/23/1996

Occurrence Type: Incident

Administrative Information

Investigator-In-Charge (IIC)

JAMES F. STRUHSAKER

Additional Persons Participating in This Accident/Incident Investigation:

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