In-flight thrust reverser deployment, Boeing 717, February 19, 2001

Micro-summary: **This Boeing 717 experienced an in-flight thrust reverser deployment following takeoff.**

Event Date: **2001-02-19 at 0730 CST**

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

Investigative Body's Web Site: **http://www.ntsb.gov/**

Cautions:

1. Accident reports can be and sometimes are revised. Be sure to consult the investigative agency for the latest version before basing anything significant on content (e.g., thesis, research, etc).

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!***

3. Reports may or may not represent reality. Many many non-scientific factors go into an investigation, including the magnitude of the event, the experience of the investigator, the political climate, relationship with the regulatory authority, technological and recovery capabilities, etc. It is recommended that the reader review all reports analytically. Even a "bad" report can be a very useful launching point for learning.

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National Transportation Safety Board

FACTUAL REPORT AVIATION

NTSB ID: CHI01IA124	Aircraft Registration Number: N2410W
Occurrence Date: 02/19/2001	Most Critical Injury: None
Occurrence Type: Incident	Investigated By: NTSB

Location/Time

Nearest City/Place	State	Zip Code	Local Time	Time Zone	
Milwaukee	WI	53207	0730	CST	

Airport Proximity:	Distance From Landing Facility:	Direction From Airport:

Aircraft Information Summary

Aircraft Manufacturer	Model/Series	Type of Aircraft
Boeing	717-231	Airplane

Sightseeing Flight: No

Air Medical Transport Flight: No

Narrative

Brief narrative statement of facts, conditions and circumstances pertinent to the accident/incident:

On February 19, 2001, about 0730 central standard time, N2410W, registered as a Boeing 717-231, operated as Trans World Airlines (TWA) flight number 73, piloted by Airline Transport Pilot rated captain and copilot, sustained an in-flight thrust reverser deployment following a takeoff from General Mitchell International Airport (MKE), near Milwaukee Wisconsin. The flight landed at MKE without further incident. The scheduled domestic passenger flight was operating under 14 CFR Part 121. Visual meteorological conditions prevailed at the time of the incident. The 2 flight crewmembers, 3 cabin crewmembers and 62 passengers were uninjured. The flight was on an IFR flight plan. The flight was originating from MKE at the time of the incident and was destined for Lambert-Saint Louis International Airport, near Saint Louis, Missouri.

Excerpts from that flight's debrief stated:

> During the cockpit preflight, the right engine's EPR display included an amber "T/R" light. The flight crew researched the QRH (quick reference handbook) and the flight handbook, and found no guidance for this problem. The Captain called the Kansas City maintenance coordinator (MCIMD) and discussed the problem with him. It was agreed that the engine would not be started with the T/R displayed. Two procedures were to be attempted by the flight crew before contract maintenance would be called: 1) pressurization of the hydraulics, followed by movement of the thrust reverse lever; and 2) an electrical "depowering" of the aircraft, followed by a total reboot of the computers.
>
> The loading was complete and the ramp service man was on the interphone; the Captain asked the agent to close the door and the flight blocked at 0614L. The flight crew completed the two procedures, with the ground crew verifying that the right engine's thrust reverse lever was not moving the buckets. Neither procedure cleared the problem T/R amber light; the flight was blocked-in at 0620 without having started an engine or moving the aircraft. (The gate in use at MKE does not involve a pushback.)
>
> The Captain phoned MCIMD and informed the coordinator that the procedures were not helpful and [contract maintenance] had been called. When the [contract maintenance] mechanic arrived, the Captain explained the problem and stated that the proposed solution was to lock out the right engine's thrust reverser and placard it as inoperative. The [contract maintenance] mechanic was careful

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and apprehensive as he reviewed the problem and stated that he would need a full hardcopy of the appropriate maintenance manual pages. He asked if there was one on the airplane, and the flight crew said there was not. The Captain explained that these pages are generally received by fax from MCIMD, which became the agreed-upon course of action.

The [contract maintenance] mechanic explained his level of training (one day of ground school and no "hands on" experience with the B717) to MCIMD during a phone call as he requested a faxed, full copy of the procedure. The Captain had introduced the mechanic to the coordinator, who was a different individual as a shift change had occurred at MCIMD. The fax was sent to the MKE station manager's office and delivered to the [contract maintenance] mechanic by the MKE operations agent. The [contract maintenance] mechanic reviewed the procedure with the Captain; a placard and a circuit breaker collar were obtained from the station personnel. The [contract maintenance] mechanic completed the procedure that involved the "pinning" of the right engine thrust reverser, and the logbook signoff was reviewed with MCIMD. The amber T/R indication was still displayed in the cockpit.

The flight departed the gate at 0720L. The takeoff was from runway 19R, followed by two turns to a westerly heading. Prior to slat retraction, at an altitude approximating 1400AGL and an airspeed of 200K, the right engine thrust reverser deployed. The airplane shuddered and rolled hard right; the T/R light was red. The Captain immediately closed the right throttle; the engine was secured shortly after the first officer was able to notify MKE departure control of an emergency and immediate need to return for landing. ATC cleared the flight for an immediate return with clearance to land on any runway. The wind at takeoff was southwesterly at 13 to 19 knots, which would require a landing on either 19R or 25L. The position of the flight was crosswind for 19R, and the distance to touchdown was shortest for 19R.

A right turn to the downwind resulted in a call from the first officer of a 1500 fpm sink rate. To maintain a 1200AGL downwind and 200K, slats extended, the Captain forced the left engine thrust lever through the gate to obtain max thrust. (When time permitted, the first officer made a PA announcement to the cabin concerning our emergency condition; that we were returning and the cabin should be prepared for landing; and that we would be on the ground shortly.) A tight traffic pattern resulted in a safe landing after 6 minutes of airtime. ...

When the Captain arrived in the MKE operations office a few minutes later, the [contract maintenance] mechanic was present and involved in a phone conversation with MCIMD. When he completed the phone call, he stated that MCIMD had not sent a fourth page that graphically depicted the pinning of the B717 thrust reverser. The B717 requires three pins to lock out the thrust reverser, and only one had been installed as had been normal with the DC9 and MD80.

The thrust reverser was removed from the incident engine and shipped to the manufacturer for

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examination. A Federal Aviation Administration engineer oversaw the examination. Retrieved system data showed that after the prior flight the reverser, when stowed, moved to stowed position and did not lock. The examination revealed that the thrust reverser doors had over deployed. Four locking pins and their fork shaped locking triggers were inspected. Nicks and gouges were found on their mating surfaces.

Subsequent to the incident, Boeing revised its 717 Dispatch Deviation Guide (DDG). The revised DDG included that maintenance would have to verify that "no more than one Thrust Reverser Proximity Sensor indicates Open" and that operators verify that the thrust reverser unlock indication is not present and red lockout pins are present on the inoperative reverser.

Subsequent to the incident, Boeing revised its Flight Crew Operating Manual (FCOM) procedure for REVERSER DEPLOYED OR U/L OR REV DISPLAYED IN FLIGHT. A step was added to the FCOM to land at the nearest suitable airport.

Subsequent to the incident the overcenter links were redesigned. Boeing and the thrust reverser manufacturer issued service bulletins (SB) to retrofit the existing engines with the new link's design change, the link's associated hardware, and rub plates. Airplanes in production will incorporate the SB items as a production change.

An excerpt from Boeing's SB 717-78-004 stated:

> BACKGROUND
> Operators have reported five instances of thrust reversers failing to deploy and ten instances of side beam gouging. Inspections revealed that gouging had occurred between the over center link bolts and side beam assembly. One recent event resulted in a relatively new thrust reverser having side beam gouging so deep, it required a doubler to restore airworthiness. Rohr Incorporated Service Bulletin R715.78-008 provides instructions to modify the thrust reverser actuation system. The purpose of modifying the thrust reverser actuation system is to minimize the possibility of gouging and inadvertent in-flight thrust reverser deployment. procedures given in this service bulletin.

An excerpt from Rohr, Inc.'s SB R715.78-008 said:

> Based upon field experience and test data, it has been found necessary to introduce a number of thrust reverser actuation system improvements. This group of improvements will result in a better-functioning, more durable, more reliable thrust reverser actuation system.
> NOTE: This Service Bulletin provides terminating action for ALERT Service Bulletin R715.78-A008.
>
> ACTIONS:
> Install rub plates on the outboard surfaces of the side beams.
> Install new overcenter links (prevent in flight deployment) (greasable bearings).
> Install new overcenter link attach hardware (improve side beam clearance and provide lubrication facility).
> Modify the thrust reverser actuators.
> Modify deflector door seal retainers (lower profile for better deflector door overstow).

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Parties to the investigation were Boeing, the Federal Aviation Administration, and Trans World Airlines.

Boeing reported that the Boeing and Goodrich service bulletins were completed for the entire fleet including stored aircraft by December 2003.

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Landing Facility/Approach Information

Airport Name	Airport ID:	Airport Elevation	Runway Used	Runway Length	Runway Width
GENERAL MITCHELL INTERNATIONAL	MKE	723 Ft. MSL	19R	9690	200

Runway Surface Type: Asphalt; Concrete

Runway Surface Condition: Dry

Type Instrument Approach: NONE

VFR Approach/Landing: Full Stop

Aircraft Information

Aircraft Manufacturer	Model/Series	Serial Number
Boeing	717-231	55077

Airworthiness Certificate(s): Transport

Landing Gear Type: Retractable - Tricycle

Homebuilt Aircraft?	Number of Seats:	Certified Max Gross Wt.	Number of Engines:
No	117	118000 LBS	2

Engine Type:	Engine Manufacturer:	Model/Series:	Rated Power:
Turbo Fan	Rolls-Royce	BR715-A1-30	18500 LBS

- Aircraft Inspection Information

Type of Last Inspection	Date of Last Inspection	Time Since Last Inspection	Airframe Total Time
Continuous Airworthiness	02/2001	Hours	770.3 Hours

- Emergency Locator Transmitter (ELT) Information

ELT Installed?	ELT Operated?	ELT Aided in Locating Accident Site?

Owner/Operator Information

Registered Aircraft Owner	Street Address		
First Security Bank NA Trustee	79 S. Main Street		
	City: Salt Lake City	State: UT	Zip Code: 84111

Operator of Aircraft	Street Address		
TRANS WORLD AIRLINES INC	11495 Natural Bridge Road		
	City: Bridgeton	State: MO	Zip Code: 63044

Operator Does Business As:

Operator Designator Code: TWAA

- 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; Domestic; Passenger Only

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Occurrence Type: Incident

First Pilot Information

Name	City	State	Date of Birth	Age
On File	On File	On File	On File	59

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; Single-engine Sea

Rotorcraft/Glider/LTA:

Instrument Rating(s): Airplane

Instructor Rating(s):

Type Rating/Endorsement for Accident/Incident Aircraft? Yes | Current Biennial Flight Review? 02/2001

Medical Cert.: Class 1 | Medical Cert. Status: Valid Medical--w/ waivers/lim. | Date of Last Medical Exam: 10/2000

- Flight Time Matrix	All A/C	This Make and Model	Airplane Single Engine	Airplane Mult-Engine	Night	Instrument Actual	Instrument Simulated	Rotorcraft	Glider	Lighter Than Air
Total Time	15744	335								
Pilot In Command(PIC)	10326	335								
Instructor										
Last 90 Days	181	181								
Last 30 Days	62	62								
Last 24 Hours	4	4								

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

Flight Plan/Itinerary

Type of Flight Plan Filed: IFR

Departure Point	State	Airport Identifier	Departure Time	Time Zone
Same as Accident/Incident Location		MKE	0720	CST

Destination	State	Airport Identifier
ST LOUIS	MO	STL

Type of Clearance: IFR

Type of Airspace: Class C

Weather Information

Source of Briefing: Company

Method of Briefing: Unknown

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Weather Information

WOF ID	Observation Time	Time Zone	WOF Elevation	WOF Distance From Accident Site	Direction From Accident Site
MKE	0452	CST	723 Ft. MSL	0 NM	0 Deg. Mag.

Sky/Lowest Cloud Condition: Few 4900 Ft. AGL

Condition of Light: Day

Lowest Ceiling: Ft. AGL

Visibility: 10 SM

Altimeter: 29.91 "Hg

Temperature: -2 °C

Dew Point: -7 °C

Wind Direction: 210

Density Altitude: Ft.

Wind Speed: 12

Gusts: 19

Weather Condtions at Accident Site: Visual Conditions

Visibility (RVR): Ft.

Visibility (RVV) SM

Intensity of Precipitation:

Restrictions to Visibility: None

Type of Precipitation: None

Accident Information

Aircraft Damage: None

Aircraft Fire: None

Aircraft Explosion None

Classification: U.S. Registered/U.S. Soil

- Injury Summary Matrix	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				62	62
- TOTAL ABOARD -				67	67
Other Ground					
- GRAND TOTAL -				67	67

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Administrative Information

Investigator-In-Charge (IIC)

Edward F. Malinowski

Additional Persons Participating in This Accident/Incident Investigation:

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