Aviation Investigation Final Report

Location:	Pittsburgh, Pennsylvania	**Accident Number:**	NYC06FA184
Date & Time:	July 27, 2006, 09:45 Local	**Registration:**	N529AU
Aircraft:	Boeing 737-300	**Aircraft Damage:**	Substantial
Defining Event:		**Injuries:**	3 Minor, 75 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

During pushback, the airplane was seen to "bounce" up and down both at the nose and the tail, before the nose gear collapsed. Examination of the airplane revealed a broken lower drag brace that was buckled in compression, and fractured due to overstress. The tug was examined and the gear shift lever was found to be defective. It would not lock in the neutral gate, and could be moved easily through the gate between the forward and reverse gears. In addition, the tug experienced "hesitation and hard jerks" when shifting from forward to reverse. Skid marks at the scene were the same width as the tug's wheelbase, and were consistent with sudden engagement of the transmission.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be: The airplane tug driver's inadvertent movement of the tug gear shift lever from forward to reverse, which resulted in the nose landing gear collapse. Contributing to the accident was the defective gear shift lever.

Findings

Occurrence #1: AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation: TAXI - PUSHBACK/TOW

Findings
1. (C) LANDING GEAR,MAIN GEAR STRUT - FRACTURED

2. (C) EQUIPMENT,OTHER - INADVERTENT - DRIVER OF VEHICLE
3. (F) AIRPORT EQUIPMENT,GROUND SUPPORT - FAILURE,PARTIAL

Factual Information

HISTORY OF FLIGHT

On July 27, 2006, about 0945 eastern daylight time (EDT), US Airways flight 231, a Boeing 737-300, N529AU, experienced a nose landing gear collapse while being pushed back from gate B-27, at the Pittsburgh International Airport (PIT), Pittsburgh, Pennsylvania. The 2 certificated airline transport pilots, 3 cabin attendants, and 73 passengers were not injured. Visual meteorological conditions prevailed, and an instrument flight rules flight plan was filed. The scheduled passenger flight, destined for Palm Beach International Airport (PBI), West Palm Beach, Florida, was conducted under 14 Code of Federal Regulations (CFR) Part 121.

In a written statement, the first officer said that during her preflight inspection, a ground crewman directed her attention to the nose landing gear wheel because it was not oriented with the nose of the airplane, but "cocked to one side." The crewman said that he might have to "realign the aircraft during the pushback."

The crew completed their preflight tasks through the "Before Start Checklist." During a "normal" pushback with the airplane in motion, the crew initiated a start on the number two engine, and the nose gear collapsed.

A review of written statements from ground crew personnel revealed that when the airplane parked at the gate, the nose wheel was aligned with the nose of the airplane. The crew installed the bypass pin, and attempted to install the tow bar in preparation for the subsequent pushback, but the nose gear migrated to the airplane's right, with no steering forces applied. Once the wheel stopped turning, the tow bar was attached, oriented about 35 to 45 degrees off the airplane's centerline.

The pushback was "normal," and the tug and the airplane aligned without difficulty. In a telephone interview, one ground crewman described the pushback as "smooth" and steady with no rapid accelerations, decelerations, or turns. He said that as the airplane slowed for the eventual disconnection of the tow bar, he heard a "snap" or "crack" and the nose gear collapsed.

A Federal Aviation Administration (FAA) inspector was in the passenger area and watched the pushback as the plane cleared the Jetway. When the aircraft came into his view he did not see anything odd until he watched the nose of the accident airplane "rise up about one foot [and] then the nose dropped to the ground...The motion of the nose was similar to a horse throwing up its head rapidly."

A US Airways employee, making a delivery in the area of the departure gate, waited for the

pushback, because the airplane blocked his path. He stated, "The tug appeared to jerk hard just as it passed the Jetway." He stated that the tug slowed, the airplane bounced, "the tail went upwards in two motions," and then the nose contacted the ground.

WRECKAGE AND IMPACT INFORMATION

National Transportation Safety Board aeronautical engineers examined the airplane at the scene on July 28, 2006. The collapse of the nose landing gear resulted in substantial damage to the aft wheel well bulkhead. Examination of the gear revealed that the lower drag brace was fractured at its center, and the flanges at the break were twisted. One fracture surface was sectioned from the brace, and forwarded to the Safety Board Materials Laboratory in Washington, D.C., for examination.

The airplane was released to the operator for repair, however; parts removed from the landing gear and landing gear steering systems during repair were retained for examination at a later date.

TEST AND RESEARCH

On August 4, 2006, the drag brace section was examined in the Safety Board Materials Laboratory. Examination of the drag brace revealed that it was deformed due to compression buckling, and the fracture surfaces were consistent with overstress fracture. There was no evidence of any preexisting cracks.

The lower drag brace was reexamined and hardness testing was conducted in the Safety Board Materials Laboratory on October 12, 2006. Rockwell hardness testing revealed that the lower drag brace fell within the hardness range for tensile strength specified in the Boeing engineering drawing.

On August 16, 2006, the hydraulic components, tested under the supervision of Safety Board engineers, included the left and right steering actuators, the depressurization steering valve, the retract actuator, and the lock actuator. All five components met their individual test requirements.

On September 21, 2006, the airplane tug was examined by an engineer and a mechanic of US Airways. Initial testing revealed that shifting gears was "difficult," and that "shifting into reverse would result in long hesitation then hard jerks before [the tug] would move smoothly." The shift lever could easily move thru the neutral gate as the shifter moved back forth between forward and reverse gears. The engineer stated that there was no spring tension in the neutral gate to prevent accidental shifting from forward to reverse. The test was suspended, and the tug was quarantined for further testing under the supervision of an FAA aviation safety inspector.

Examination of the tug was repeated under the supervision of the FAA inspector. The tug was also driven forward at low speed, and the shift lever was moved thru the gate into reverse gear.

According to the engineer, the force "nearly threw the driver out of the tug...This is believed to be the same violent force that acted on [the accident airplane's] nose gear." Examination also revealed that the transmission required servicing with "several cans" of transmission fluid. Following the tests, a new shifter was installed on the tug before it was placed back into service.

Examination of photographs of parallel skid marks at the scene revealed that the distance between them was identical to the tug's wheelbase, and were consistent with sudden engagement of the transmission.

The FAA inspector reviewed the operator's report, and concurred with its findings.

The flight data recorder (FDR) and the cockpit voice recorder (CVR) were forwarded to the Safety Board Recorders Laboratory in Washington, D.C. for examination. The recorders were reviewed by Safety Board staff, but no significant or pertinent details were noted. Therefore, a recorder group was not formed, and no transcripts were published.

METEOROLOGICAL INFORMATION

The weather reported at Pittsburgh International Airport included few clouds at 6,000 feet, with winds from 220 degrees at 10 knots. The temperature was 25 degrees Celsius, and the dew point was 20 degrees Celsius.

Pilot Information

Certificate:	Airline transport	**Age:**	58,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Unknown	**Last FAA Medical Exam:**	
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	March 1, 2006
Flight Time:	18227 hours (Total, all aircraft), 1933 hours (Total, this make and model)		

Co-pilot Information

Certificate:	Airline transport	**Age:**	51,Female
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Unknown	**Last FAA Medical Exam:**	
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	May 1, 2006
Flight Time:	12505 hours (Total, all aircraft), 2306 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N529AU
Model/Series:	737-300	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	24411
Landing Gear Type:	Retractable - Tricycle	**Seats:**	128
Date/Type of Last Inspection:		**Certified Max Gross Wt.:**	79000 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:		**Engine Manufacturer:**	CFM International
ELT:	Installed, not activated	**Engine Model/Series:**	
Registered Owner:	Wells Fargo Bank Northweat NA Trustee	**Rated Power:**	
Operator:	US AIRWAYS INC	**Operating Certificate(s) Held:**	Flag carrier (121)
Operator Does Business As:	US Airways	**Operator Designator Code:**	USA4

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KPIT,1203 ft msl	**Distance from Accident Site:**	
Observation Time:	09:51 Local	**Direction from Accident Site:**	
Lowest Cloud Condition:	Few / 6000 ft AGL	**Visibility**	7 miles
Lowest Ceiling:	Broken / 11000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	10 knots /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	220°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29.96 inches Hg	**Temperature/Dew Point:**	25°C / 20°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	PITTSBURGH, PA (PIT)	**Type of Flight Plan Filed:**	IFR
Destination:	WEST PALM BEACH, FL (PBI)	**Type of Clearance:**	None
Departure Time:	09:45 Local	**Type of Airspace:**	

Airport Information

Airport:	Pittsburgh International PIT	**Runway Surface Type:**	
Airport Elevation:	1203 ft msl	**Runway Surface Condition:**	
Runway Used:		**IFR Approach:**	None
Runway Length/Width:		**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	1 Minor, 4 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	2 Minor, 71 None	**Aircraft Fire:**	None
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	3 Minor, 75 None	**Latitude, Longitude:**	40.488056,-80.226387

Administrative Information

Investigator In Charge (IIC):	Rayner, Brian
Additional Participating Persons:	Dale Hoth; FAA/FSDO; Pittsburgh, PA Michael Tallarico; US Airways; Pittsburgh, PA Richard Anderson; Boeing; Seattle, WA
Original Publish Date:	June 30, 2008
Last Revision Date:	
Investigation Class:	Class
Note:	The NTSB traveled to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=64205