

PB87-910408



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D. C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY REPORTS

UNALASKA, ALASKA - - SEPTEMBER 25, 1985

JENKINSBURG, GEORGIA - - SEPTEMBER 29, 1985

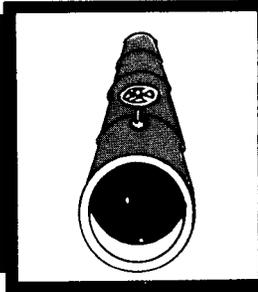
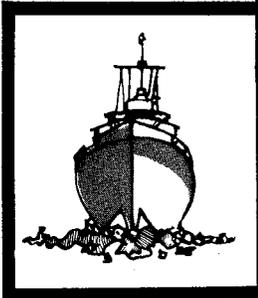
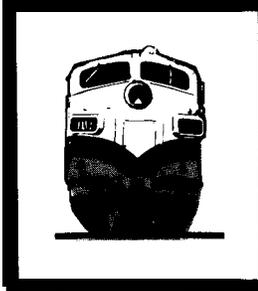
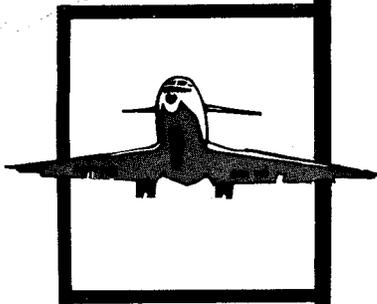
BOSTON, MASSACHUSETTS - - DECEMBER 15, 1985

DEKALB, TEXAS - - DECEMBER 31, 1985

ERIE, PENNSYLVANIA - - FEBRUARY 21, 1986

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National Transportation Safety Board

Washington, D.C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No.:	2855
Aircraft Operator:	MarkAir, Inc.
Aircraft Type:	Boeing 737-2X6C
Aircraft Registration:	N674MA
Location:	Unalaska, Alaska
Date and Time:	September 25, 1985, 1333 Alaska daylight time
Occupants on Board:	Crew-4; passengers-17
Injuries:	One passenger-minor injuries
Aircraft Damage:	Substantial
Type of Occurrence:	Touchdown short of runway
Phase of Operation:	Landing

On September 25, 1985, at 1333 Alaska daylight time, 1/ MarkAir flight 71, a Boeing 737 operating as a certificated air carrier under 14 Code of Federal Regulations Part 121, touched down 72 feet short of runway 12 while landing at the Unalaska Airport, Unalaska, Alaska (commonly called Dutch Harbor). Of the 17 passengers and 4 crewmembers on board, 1 passenger sustained a minor injury. The airplane was substantially damaged. The scheduled daily passenger/cargo flight from Anchorage to Unalaska was operating on an instrument flight rules flightplan in visual flight rules conditions at the time of the accident.

Dutch Harbor Airport is a certificated airport under 14 CFR Part 139, and it has one compacted gravel runway (12/30) which is 3,900 feet long and 100 feet wide. The runway is surrounded by water and mountains, and there are no safety areas or clearways at either end. Runway 12 has runway end identification lights and runway end reflective markers. A vertical cliff is situated 56 feet from and parallel to the left side of runway 12 near the approach end. This cliff rises rapidly to a height of 1,634 feet, and because of its proximity to the runway, the wind often produces localized drafts affecting the landing of airplanes on runway 12. There are no instrument approach procedures or nav aids available to the Dutch Harbor Airport.

Before the 1126 departure from Anchorage, flight 71 was delayed for about an hour due to strong, gusty winds at Dutch Harbor associated with frontal weather activity in the area. According to the captain, flight 71 had been cancelled, and he was on his way home when he was called back for the flight. He stated that, considering the weather at Dutch Harbor, he was very surprised that the flight was rescheduled.

According to the Significant Meteorological Report Charlie 4, valid until 1430, September 25, 1985, the Aleutian Islands (Dutch Harbor included) were forecast to have moderate to occasionally severe turbulence below 10,000 feet due to strong low level winds and associated wind shear with turbulence spreading eastward and continuing after 1430. The 0951 Hourly Weather Observation and the previous four observations at Dutch Harbor reported rain. Notice to Airmen No. 09/007, effective from 0868 on September 25, 1985, to 0803 on September 26, 1985, read "Dutch Harbor Airport has 3 inches of standing water on runway 12/30 north end." MarkAir's procedures preclude dispatch of the airplane with standing water on the runway. Not only was flight 71 dispatched, but the captain received several en route reports of water still on the runway.

1/ All times are Alaska daylight time, based on the 24-hour clock.

Flight 71 started breaking out of the clouds at about 10,000 feet mean sea level and established visual flight conditions at approximately 6,000 feet. The flight encountered occasional light turbulence during the approach to Dutch Harbor. Because of the difficult landing conditions at Unalaska, **MarkAir's** procedures mandated that the captain fly the airplane during the approach and landing. In addition, **MarkAir's** operations specifications contain special limitations with which the operator must comply. Included are landing and takeoff weight limits, wind and weather restrictions, flightcrew training requirements, mandatory use of maximum autobrake during landing, airplane touchdown zone limitations, and special aborted takeoff procedures.

Flight 71 made initial ground contact in the gravel area 72 feet short of the runway 12 threshold. This area was cluttered with large rocks, logs, and other debris brought in by the frequent high winds and water from the adjoining Unalaska Bay (about 30 feet from the corner of the runway). This area, extending from the threshold of runway 12 to the shoreline, is uneven and unmaintained, and has an approximate slope of 2°.

According to the cockpit voice recorder (CVR), about 3 minutes before impact, the captain asked **MarkAir's** Dutch Harbor Operations about the status of water on the runway and was told, "very little, its been graded off very nice; our center line is missing because of the grading."

According to the flight data recorder readout, at 570 feet above ground level (agl), the airplane encountered a 15.7-knot increase in indicated air speed during a 2-second period. The Boeing 737 Aircraft Flight Manual states that the approach should not be continued if the indicated air speed changes 15 knots or more below 500 feet.

The airplane's left main landing gear tires hit the ground first about 72 feet short of the runway threshold. The entire airplane momentarily became airborne, then struck and rolled over the top of a log 10 feet long and 15 inches in diameter and a rock about 2 feet in diameter. The log and rock were 52 feet from the runway threshold.

Immediately upon touchdown, the left main landing gear collapsed to a trailing position. As a result, the left engine hit the runway and it separated from the wing. The airplane continued down the runway with the left wing dragging. The airplane came to rest about 1,218 feet beyond the runway threshold, just off the left side of the runway.

Wing and engine parts of various sizes were scattered from the point where the left engine first contacted the runway to where the airplane came to rest. The left wing and most of its leading and trailing edge lift devices were heavily damaged. The underside of the left wing and a fuel tank were punctured allowing fuel to spill to the ground. Fire trucks were on the scene within 2 to 3 minutes and foamed the area. The left engine was heavily damaged, and the first several stages of the fan section in the right engine had internal foreign object damage. The number one and number three tires were blown.

The 17 passengers and 2 flight attendants were evacuated while the pilots performed the emergency shutdown procedures. Of the 21 persons on board, 15 reportedly left the airplane by the left rear exit and 6 left by the left **overwing** emergency exit.

The effect of the wind on the aircraft's speed was evident from the CVR conversation. The first officer was supplying the captain with airspeed **callouts** during the approach. These **callouts** were in the form of knots above Vref. While on a short final approach, one of these calls was "plus 15." At that time, a corresponding reduction in engine noise could be heard on the CVR. Because **MarkAir's** procedures for Dutch Harbor do not allow for wind additives, all approaches are conducted at Vref.

During the approach the captain and the first officer made comments that indicated that they were not comfortable landing at this airport. The captain had made only nine landings at Unalaska, and the first officer had made only four, all while acting as the first officer for this captain. The captain also stated that it might be a harder-than-normal landing. Later, the captain explained that because of the short runway at Dutch Harbor, it was necessary to land the airplane a bit firmer to get it stopped before the airplane reached the end of the runway. The captain also stated that he had forgotten his sunglasses and was bothered by **sunglare** during the approach.

At least seven persons at the Unalaska Airport witnessed some or all of the approach and accident. Two witnesses, both active commercial pilots, said that on approach, flight 71 suddenly dropped below the established descent path, leveled off, and then suddenly dropped again just before impact. These witnesses also stated that the winds were about 120° at 10 to 15 knots, gusty and variable. One of these witnesses, also a National Weather Service (NWS) certified weather observer, stated that from his experience, whenever the wind was blowing from about 120° through the east to about 300° at 10 to 15 knots or above, an aircraft would always encounter downdrafts during the approach to runway 12. He stated that aircraft could encounter a downdraft just off the end of Hog Island (about 4,000 feet short of the threshold of runway 12) followed by another downdraft just before reaching the shoreline adjacent to the runway 12 threshold.

Following the accident, many other Unalaska pilots confirmed that downdrafts, or "sinkers" as they were commonly called, **ocurred** frequently off the approach end of runway 12. Several pilots reported aircraft coming dangerously close to crashing after encountering one of these downdrafts. Numerous reports were received concerning the unreliable wind information disseminated by the Unalaska weather station. In fact, while on final approach, the captain doubted the accuracy of the reported winds (140° at 8 knots).

It reportedly was not uncommon to see the airport's two windsocks pointing in opposite directions and standing straight out. When queried about this matter, the NWS in Anchorage responded that the Unalaska wind instruments were installed in accordance with their criteria and they had no plans to install additional windsocks.

The Supplementary Aviation Weather Reporting Station (SAWRS) at Unalaska Airport had been certified by the NWS on February 7, 1985. Employees of Reeve Aleutian Airways, who had received NWS certification, made weather observations for the certificated Parts 135 and 121 operations at the Unalaska Airport. The last inspection of the Unalaska SAWRS by the Federal Aviation Administration (FAA) had been on July 7, 1985. The following remark was noted: "**Reeve Station Manager Huffman** stated that he does not believe the wind meter gives an accurate direction when wind is from the **east.**"

In December 1966, the captain was hired by **MarkAir**, then known as Alaska International Air. He held an Airline Transport Pilot Certificate with a multiengine land rating and commercial **privileges** in airplane single-engine land and sea. He held type ratings in the Boeing 737 and the Lockheed L-382. His First Class Medical Certificate was issued May 23, 1985, with no limitations. He completed the Boeing 737 Transition Course on February 11, 1984, and was upgraded to captain on February 28, 1984. His last line, route, and airport qualification check was completed on August 2, 1985, and his proficiency check was on August 18, 1985. The captain had been a **MarkAir** Company Check Airman for the Lockheed L-382 for several years and for the Boeing 737 for a short time. He had a total of 14,969 hours flight time, 1,173 hours of which were in the Boeing 737.

The first officer was hired by **MarkAir** on April 16, 1984. He held an Airline Transport Pilot Certificate with an airplane multiengine land rating and commercial privileges in airplane single-engine land rating and commercial single-engine land and sea. He held a type rating in the Boeing 737. He also held a Pilot Engineer Certificate with a turbo jet rating, a Flight Navigator Certificate, and a Flight Instructor Certificate with a single-engine airplane rating. His First Class Medical Certificate was issued May 16, 1985, with a limitation to wear corrective lenses while exercising the privileges of his airman certificate. He stated that he was wearing prescription sunglasses at the time of the accident. He completed the Boeing 737 transition on May 29, 1984, a proficiency check on September 4, 1985, Dutch Harbor Airport qualification on September 5, 1985, and a line check on September 6, 1985. He had accumulated about 8,090 total flight hours, 419 hours of which were in the Boeing 737. There was no indication that any medical or physiological problems affected the performance of the crewmembers.

The airplane, a Boeing **737-2X6C, N674MA**, serial number 23292, had been purchased by **MarkAir** on July 5, 1985. It was certificated in accordance with applicable FAA regulations and was maintained in accordance with an approved airplane inspection program. The airplane was powered by two Pratt and Whitney **JT8D-17A** turbofan engines. Both engines and the airplane had a total of 614 operating hours since its manufacture. The airplane is approved for 120 passenger seats. The forward-most 44 passenger seats had been replaced by two cargo bins and, at the time of the accident, the bins contained 6,221 pounds of various types of cargo. The airplane's maximum allowable takeoff and landing weights were 128,100 and 107,000 pounds, respectively. The takeoff weight from Anchorage was 102,462 pounds and the estimated landing weight at Dutch Harbor was 89,955 pounds. Due to certain conditions and characteristics of Dutch Harbor the airplane's maximum approved takeoff and landing weights for the airport were lowered to 95,000 and 91,600 pounds respectively (for zero wind conditions). According to Boeing engineers, with the existing conditions at the time of the accident, the dry landing field length required for the airplane would have been 3,700 feet (14 CFR Part 121.195). The pilots had calculated the landing approach reference speed (**Bug/Vref**) at 122 knots indicated air speed (**IAS**). The FDR readout showed that **the** average **IAS** and rate of descent during the 5 seconds before impact was 118.9 knots and 384 feet per minute, respectively. The **IAS** at touchdown was 117.6 knots. The average approach angle for the last 33 seconds before impact was approximately **1.6°**.

An inspection of the runway revealed that the approach end of runway 12 was not marked as required. One marker cone was completely out of sight in a washed-out gully. Flotsam had washed up and had covered the area immediately short of the runway 12 threshold. In addition, during high tide, the airport has been known to flood and leave debris on the runway. In fact, the visual approach slope indicators (**VASI**) have been washed away when it floods. Runway 30 is equipped with a **VASI**; however, the runway 12 **VASI** had been destroyed by a storm on December 5, 1980. Its reinstallation had been delayed pending runway improvements planned by the State of Alaska. Funding complications had reportedly caused delays in the planned improvements. Various studies were made over the years; the latest was estimated to cost \$5.1 million. The FAA had granted an exemption from the requirements of CFR 139.45 pertaining to "safety areas" surrounding the runway.

When **MarkAir** requested FAA to authorize the use of the B-737 for the scheduled route to Unalaska, personnel from both the Federal and State Airports Division stated that in their opinion, it was not safe to operate the Boeing 737 into that airport. On a video taken during the operations' initial approval flight at Unalaska, an FAA principal operations inspector said, "If a pilot's not mighty careful, hell land short of the runway."

Since this accident, at least 14 Boeing **737-rated** pilots who operate into Dutch Harbor have been contacted who have knowledge of these operations. Without exception, all the pilots expressed very strong opinions that notwithstanding the unpredictable winds and downdrafts, the short runway, and the lack of safety areas made an over-water visual approach to the Unalaska Airport unsafe, especially without a VASI or some other type of glideslope assistance.

In conclusion, evidence indicates that the **MarkAir** aircraft encountered a wind condition on short final approach which caused the approach to become destabilized; subsequently, airspeed decayed significantly below V_{ref} , and the aircraft was allowed to descend well below the desired glide path.

On November 14, 1985, the Safety Board issued Safety Recommendations A-85-127 and -128 to the FAA, based on the preliminary investigation.

Reduce the effective length of the runway at the Dutch Harbor Airport, Unalaska, Alaska, to 3,000 feet for the purpose of determining aircraft suitability for passenger carrying operations under 14 CFR Part 121.

Improve the surveillance of the Dutch Harbor Airport, Unalaska, Alaska, to verify that runway markers, landing aids, and areas surrounding the runway surface are installed and adequately maintained.

In the response to Safety Recommendation A-85-127, dated March 3, 1986, the FAA stated that the **MarkAir** operation was safe, and that the FAA will continue its surveillance of the operation. On April 15, 1986, the Safety Board classified this action "**Open -Unacceptable Action.**"

In response to Safety Recommendation A-85-128, the FAA stated that the following improvements would be made to the Dutch Harbor runway:

- (1) Replacing runway markers;
- (2) Regrading the runway;
- (3) Increasing effort to keep the area between the runway 12 threshold and the water clear of debris; and
- (4) Reinstalling the VASI.

Additionally, the FAA reported that the State of Alaska plans to reorient and lengthen runway **12/30**. As a result, the Safety Board classified this safety recommendation as "**Closed--Acceptable Action.**"

The attached brief of accident contains the Safety Board's findings of probable cause relating to this accident.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

May 28, 1987

Brief of Accident (Continued)

File No. - 2855

9/25/85

UNALASKA, AK

A/C Reg. No. N674MA

Time (Lcl) - 1333 ADT

Occurrence #1 UNDERSHOOT
Phase of Operation APPROACH - VFR PATTERN - FINAL APPROACH

Findings(s)

1. PLANNING-DECISION - IHPROPER - COHPANY/OPERATOR MGMT
2. INSUFFICIENT STANDARDS/REQUIREMENTS, OPERATION/OPERATOR - FAA(ORGANIZATION)
3. AIRPORT FACILITIES - INADERUATE
4. OTHER AIRPORT/RUNWAY HAINTENANCE - INADEQUATE -
5. INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
6. INADEQUATE SURVEILLANCE OF OPERATION - OTHER GOVT ORGANIZATION
7. PLANNED APPROACH - INITIATED - PILOT IN COMMAND
8. IMPROPER DECISION, COMPANY-INDUCED PRESSURE - PILOT IN COHHAND
9. LIGHT CONDITION - SUNGLARE
10. IMPROPER USE OF EQUIPMENT/AIRCRAFT, VISUAL/AURAL PERCEPTION - PILOT IN COHHAND
11. AIRPORT FACILITIES, VISUAL APCH SLOPE IND(VASI) - UNAVAILABLE
12. WEATHER CONDITION - UNFAVORABLE WIND
13. WEATHER CONDITION - WINDSHEAR
14. COMPENSATION FOR WIND CONDITIONS - INADERUATE - PILOT IN COHHAND
15. PROPER TOUCHDOWN YOINT - NOT ATTAINED - PILOT IN COHHAND
16. IHPROPER USE OF EQUIPMENT/AIRCRAFT, LACK OF FAHILIARITY WITH GEOGRAPHIC AREA - PILOT IN COHHAND

Occurrence #2 IN FLIGHT COLLISION WITH TERRAIN
Phase of Operation LANDING - FLARE/TOUCHDOWN

Findings(s)

17. TERRAIN CONDITION - ROUGH/UNEVEN
18. TERRAIN CONDITION - LOOSE OBJECTS

Occurrence #3 ON GROUND COLLISION WITH ORJECT
Phase of Operation LANDING

Occurrence #4 MAIN GEAR COLLAPSED
Phase of Operation LANDING

Findings(s)

19. ~~LANDING GEAR, MAIN GEAR - OVERLOAD~~

---Probable Cause---

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are findings(s) 1,14,15

Factor(s) relating to this accident is/are findings(s) 2,3,4,5,6,9,10,11,12,13,16,17,18



AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No: 1664
Aircraft Operator: Air Carriers Express Services, Inc.
Aircraft Type and Registration: Cessna 208, N551CC
Location: Jenkinsburg, Georgia
Date and Time: September 29, 1985, 1230 eastern
daylight time
Persons on Board: 1 crew, 16 passengers
Injuries: 17 fatal
Aircraft Damage: Destroyed
Other Damage or Injuries: None
Type of Occurrence: Collision with ground
Phase of Operation: Uncontrolled descent

About 1230 on September 29, 1985, a Cessna 208, N551CC, crashed during an uncontrolled descent. The pilot and 16 parachutists were fatally injured, and the aircraft was destroyed. The airplane was registered to Air Carriers Express Services, Inc., (ACES) and was being flown for sport parachute operations under 14 CFR Part 105 and visual flight rules (VFR). Visual meteorological conditions prevailed, and no flight plan was filed. The weather was clear, and the temperature at the parachute center was reported to be 78° F. The owner of the airplane, who also was the President of ACES, was one of the parachutists onboard the airplane.

Shortly before the accident, the airplane departed the sod runway of the West Wind Sport Parachute Center at Jenkinsburg, Georgia, with the parachutists for a mass jump from 12,500 feet. Witnesses familiar with the operation of the airplane stated that the takeoff roll was longer than normal, that the airplane speed was slower than normal, and that the climb angle was shallower than normal. The airplane climbed to an estimated altitude of 300 feet, rolled steeply to the left, and spiraled to the ground in a steep nose-down attitude. One witness reported that the propeller rotation visibly slowed just before the banking maneuvers. The airplane impacted nose-down in a pasture about 8/10 of a mile southeast of the parachute center. There was no fire.

The pilot was properly certificated for the operation and held a first class medical certificate with no limitations. The pilot's logbook indicated that the pilot had 4,907 flight hours; with 1,121 hours in single-engine aircraft and 306 hours in turboprop aircraft. No entries were noted after August 28, 1985, and no flights in a Cessna 208 were logged. The pilot was hired about a week before the accident to pilot N551CC during parachute operations and 14 CFR Part 135 operations. His father reported that the pilot had flown about 15 hours in N551CC the week before the accident while engaged in sky diving operations in Illinois.

Postmortem examination of the pilot did not reveal any medical conditions that could have affected his performance. Toxicological examinations were negative for drugs and alcohol.

The postaccident inspection of the wreckage revealed that there was continuity of the flight control cables from the area of the cockpit to the flight control surfaces. The position of the flap actuating jackscrews indicated that the flaps were extended 20° at the time of impact. The approved takeoff range listed in the aircraft flight manual is 0° to 20°. There was no evidence of a flight control failure before the accident.

No fuel was found in the ruptured left-wing fuel tank. Approximately 23 gallons of jet fuel was removed from the right-wing fuel tank. The fuel contained water and an unknown solid foreign matter. The composition of the solid material was not determined, but it had the appearance of brown algae. The fuel reservoir ^{1/} did not contain any fuel. The reservoir manifold assembly fuel line, which transports pressurized fuel to the engine, was fractured; fuel in the reservoir would have drained out since the wreckage was on its nose. The reservoir interior was coated with intermittent, dark brown to black spots, which had the appearance of algae.

The airplane fuel filter and the engine fuel pump filter were removed and inspected. The airframe filter element was covered with a dark, stringy foreign material. The composition of this material was not determined, but it also had the appearance of algae. The engine fuel pump paper filter was covered with a similar dark, stringy, foreign material. Less than a teaspoonful of what appeared to be Jet A fuel flowed from the engine fuel pump filter canister when it was opened.

The Pratt and Whitney PT6A turboprop engine was sent to the manufacturer for a teardown examination. Damage to the engine was found to be consistent with no-engine rotation at the time of the impact. About 22 milliliters of a milky fluid was recovered from the engine fuel control. Laboratory analysis showed it to be 64 percent Jet A fuel and 36 percent water. Contaminants filtered from the fluid were found to be 95 percent iron. Data from the manufacturer concerning an earlier water/fuel injection test on a PT6A engine indicated that, at take-off condition with ignition off, the engine flamed out and did not recover when approximately .11 U.S. gallon of water was injected over a 5-second period into the fuel supply close to the engine.

On September 26, 1986, 500 gallons of Jet A fuel was delivered to the parachute center by a local distributor. The fuel was pumped into nine 55-gallon drums used to store fuel for N551CC; all of the drums were located outside. *The driver of the fuel pumper truck stated that he opened all of the drums, tipped two of them on end to allow any residual contents to drain out, and smelled the remaining drums before filling them.* According to the driver, three other drums contained water and sludge and were not used.

^{1/} The fuel reservoir is located below the floorboards forward of the main landing gear; it is gravity fed by the two wing tanks. The reservoir contains the fuel boost pumps and is the low point in the fuel system.

After the accident, fuel from the airplane wreckage was placed in an empty drum from the parachute center. At that time, all drums were observed to be in an upright position with water standing on the tops of the drums. When the drums were disturbed, air bubbles were seen coming from the filler and vent caps, indicating that water was seeping around the caps into the drums.

Further investigation revealed that the airplane had a history of fuel contamination. On the weekend of September 14, 1985, the airplane reportedly was refueled from 55-gallon drums containing contaminated fuel, while in Xenia, Ohio, to conduct sport parachute operations. Witnesses said that the engine quit on a takeoff roll while the airplane was being piloted by the owner, a certificated pilot. All of the fuel was supposedly drained from the airplane and replaced with uncontaminated fuel. The airplane was flown back to Dekalb-Peachtree Airport (PDK) in Chamblee, Georgia, where it was based.

On September 18, 1985, the owner flew the airplane to a nearby repair facility. According to the work order for the airplane, the main fuel screen and fuel pump inlet and outlet screens were cleaned, and the EPA can 2/ and fuel sump were drained. The mechanic who cleaned the fuel sump filters said that the airframe filter had water droplets, muddy-brown discoloration, and trash particles; that syrup-like black/brown material was drained from the fuel reservoir (header tank); and that about 4 gallons of fuel was drained from the fuel reservoir before the fuel cleared in color. The mechanic stated that he informed the owner of the findings and suggested that the fuel system be purged; the owner replied that he had drained the system.

On September 25, 1985, the chief pilot for ACES flew a training flight to prepare a pilot employed by another air-taxi operator, Midnite Express, Inc., for a 14 CFR Part 135 checkride in N551CC. The training was being accomplished in anticipation of a charter agreement between ACES and Midnite Express, Inc., whereby the latter would rent N551CC during weekdays for cargo runs on its own routes. Both pilots said that after the training flight, the airframe fuel filter bypass indicator 3/ was displayed. The bypass indicator was reset and the aircraft was ferried from PDK to the Midnite Express Facility at nearby Fulton County Airport (FTY), to position it for the upcoming checkride.

On the morning of September 27, 1985, the Director of Maintenance for Midnite Express, Inc., checked the airplane fuel. He said that he found the fuel to be "highly contaminated with what looked like micro (sic), water, dirt and possibly a deteriorating bladder due to its black color." When the Federal Aviation Administration (FAA) inspector arrived at the airplane for the checkride, a mechanic informed him that the aircraft could not be flown due to fuel contamination. The inspector later stated that he examined four samples of fuel taken from the left wing sump and that he noted that each sample contained solid black/brown colored contamination covering the bottom of the sample jar. The inspector also noted that the airframe fuel filter

2/ The EPA can is used to collect fuel rejected by the engine during normal shutdown, and it is used to prevent fuel from draining overboard.

3/ The bypass indicator indicates that the fuel filter is blocked with foreign material and that fuel is bypassing the filter.

bypass indicator was displayed. He reported that he cancelled the checkride and that after learning from Midnite Express, Inc., personnel that the chief pilot for ACES had been told of the fuel contamination, he returned to his office. An Aircraft Condition Notice (FAA Form 8620.1,) was not issued.

That afternoon, the Director of Maintenance for Midnite Express, Inc., informed the owner of N551CC by telephone that the fuel was contaminated. Later that day, the Director of Operations for Midnite Express, Inc., advised the owner by phone of the contamination. The owner reportedly responded by explaining the airplane's past contamination history, and he described the precautions taken, saying they were sufficient. The owner arrived at the facility later in the afternoon to fly the aircraft away; he was advised that the airplane should not be flown. The owner commented that he had checked the fuel and that it was still contaminated, but that he did not feel it was sufficient to ground the aircraft. The owner departed FTY in the aircraft that evening and returned to its base, DeKalb-Peachtree Airport.

FAA Order 8430.1 (Air Carrier Operations Inspector's Handbook) states that during a ramp inspection, if an aircraft deficiency is noted, an Aircraft Condition Notice will be issued. Although the FAA inspector's examination of the airplane involved an initial checkride, once the checkride had been cancelled, the aircraft examination became, for all practical purposes, a ramp inspection. Normally, an Aircraft Condition Notice is delivered to the appropriate manager of the carrier or, if that cannot be accomplished, the Aircraft Condition Notice is affixed to the aircraft in a conspicuous location. The purpose of the notice is to make the carrier aware of a deficiency and warn against flying the aircraft until the deficiency is corrected. The chief of the inspector's assigned operations unit stated that operations inspectors normally do not carry nor issue Aircraft Condition Notices and that airworthiness inspectors are responsible for issuance of the notices. An airworthiness inspector was not contacted to inspect the aircraft and/or to take appropriate action to assure that it was not operated before corrections were accomplished. The Safety Board believes that it is possible the accident may have been prevented if the operations inspector had taken all the options available to prevent the aircraft from being flown until the deficiency was removed.

On September 28, the aircraft was flown to the West Wind Sport Parachute Center in Jenkinsburg where parachute operations were conducted without any reported problems. One parachutist reported that he saw the owner checking fuel from one of the drums. He said that the owner squirted fuel onto the ground, that the fuel had an amber color at first, "like rust from the bottom of the drum," and that it became clear after about 4 seconds. A portable battery-powered pump was used to pump the fuel from the drums.

On September 29, 1985, the aircraft returned to the West Wind Sport Parachute Center from PDK. The aircraft reportedly was refueled from one of the 55-gallon drums at the jump center before any parachute operations. It was estimated to have departed with 60 gallons of fuel onboard.

A pilot who previously had worked for the owner and had conducted sport parachute operations stated that it was normal procedure to disengage the stall warning circuit breaker during flights with skydivers. The procedure

was used since the sounding of the stall warning horn reportedly startled the skydivers. The position of the stall warning circuit breaker at the time of the accident could not be determined due to impact damage.

An estimated weight and balance at the time of the accident was calculated using the aircraft weight and balance records, individual weight records, and witness statements. Individual weights were obtained from records at the parachute center, and an average weight of 26 pounds per person for parachute equipment was added. Witnesses familiar with the seating arrangements in the aircraft during parachute operations provided the probable loading distribution; 15 jumpers were seated three abreast in five rows, and 1 jumper was seated next to the pilot. All jumpers were seated on the floor of the airplane facing aft and were not wearing seatbelts. Although 17 passenger seatbelts were installed in the aircraft, the seatbelts were found generally attached to the same attachment ring in a cluster. The aircraft was estimated to be 370 pounds over gross weight and 1 inch forward of C.G. limitations.

In prior parachute operations, the aircraft was routinely flown with 14 to 16 parachutists onboard and sometimes with as many as 18. Parachutists who rode in the airplane during such operations reported that the airplane generally had no problem handling such loads. The airplane was certificated for nine passenger seats, in addition to the pilot's seat.

It is not known if any attempt was made by the parachutists to exit the aircraft before the accident. A parachutist who jumped from the plane the previous day remarked that parachutists in general are trained to stay in the aircraft if the engine quits below 1,000 feet above the ground. Witnesses to the accident generally agreed that the aircraft ascended no more than 300 to 500 feet above the surrounding terrain.

The investigation of this accident revealed that the airplane had been operated for several weeks with known contamination of the fuel system. Even though the owner/operator was informed by qualified maintenance personnel on at least two occasions of the need to purge and clean the airplane's fuel system before further flight, he continued to operate the aircraft. On at least one occasion, the airplane was flown after contaminated fuel samples were repeatedly obtained. The aircraft flight manual states that all drain valves should be thoroughly drained until there is no evidence of water or sediment contamination before the flight.

The fueling history of N551CC strongly suggests that water entered the fuel via natural means. The 55-gallon drums used to store the airplane fuel at the parachute center were outdoors, which would allow for normal heating and cooling. Further, the drums were upright and the filler and vent caps were not tight, which would allow rainwater standing on the drum tops to seep into the drums. A witness noted "rust" colored fuel dispensed from at least one drum.

The extent of the accident pilot's knowledge of the airplane's fuel contamination history is not known. Witnesses reported that he checked fuel samples drained from the airplane's wing tanks just before the accident flight, though it is not known whether or not he observed any contamination.

Steep turning maneuvers by the airplane were observed shortly after departure; witness observations of these maneuvers were consistent with an attempt to return to the runway. These maneuvers were preceded by an apparent engine failure caused by fuel contamination, and culminated in a departure from controlled flight and subsequent ground impact in an adverse attitude. The loss of control, or stall, was probably aggravated by the disabling of the stall warning system.

The investigation revealed that ACES was issued an Air Carrier Operating Certificate for passenger and cargo, day/night, air taxi on-demand operations under visual and instrument flight rules. Although not a causal factor, the certification of ACES as an air carrier was examined. No evidence was found in the air carrier records maintained by ACES that any employee had completed the company training required for air taxi operations. There was no record that any pilot for ACES had completed ground or flight training for air taxi operations. The director of operations/chief pilot was a full-time employee for AT&T. When interviewed, he displayed little knowledge of the operator's manual, contrary to 14 CFR 135.39.

In accordance with 14 CFR 135.63, an air carrier operator is required to maintain records of a pilot's aeronautical experience "in sufficient detail to determine the pilot's qualifications to pilot aircraft in operation under this part...." No record was found of pilot qualifications for persons named as ACES pilots by the director of operations.

The principal operations inspector assigned to ACES stated that he could not recall if ACES had training records required by 14 CFR 135.323 when the initial base inspection of the operator was conducted. He also stated that the training records, however, normally would be reviewed when the pilots receive a checkride and that the training records would be examined by the inspector conducting checkrides of the operator's pilots. No pilot training records were found during the investigation of the accident.

Title 14 CFR 135.37 requires that one of the management personnel of each certificate holder be designated as a director of maintenance. The principal maintenance inspector for ACES stated that a director of maintenance was not required in this instance since the operator had an agreement with a repair facility to assure that required maintenance would be performed. He provided a letter from the operator which named a repair facility's inspector as the person responsible for the duties of the director of maintenance. The repair facility inspector said that he did not assume any responsibility for ACES other than to conduct requested maintenance on its airplane and that he was *not aware the aircraft was to be inspected and maintained under 14 CFR Part 135*. As a result, the operator had no director of maintenance as required by 14 CFR 135.37.

Title 14 CFR 135.71 requires that operators establish a procedure through which a pilot can determine the airworthiness of the aircraft before flight. The manual for ACES stated that a status board would be kept in the operator's offices for that purpose. A status board was not found during the investigation and the director of operations/chief pilot said he was not aware that a status board existed. Discrepancies discovered during the accident investigation indicated that the operator did not meet the requirements of 14 CFR Part 135 for issuance of an Air Carrier Operating Certificate.

The attached Brief of Accident contains the Safety Board's conclusions, findings of probable causes, and related factors.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

May 18, 1987

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 1664 9/29/85 JFNKINSBURG,GA A/C Reg. No. N551CC Time (Lcl) - 1230 EDT

-----Basic Information-----

Type Operating Certificate-ON-DEMAND AIR TAXI		Aircraft. Damage	Injuries			
Type of Operation	-SKYDIVING	DESTROYED	Fatal	Serious	Minor	None
Flight Conducted Under	-14 CFR 105	Fire	Crew	0	0	0
Accident Occurred During	-DESCENT	NONE	Pass	16	0	0

-----Aircraft Information-----

Make/Model	- CESSNA 208	Eng Make/Model	- P&W PT6A-114	ELT Installed/Activated	- YES/YES
Landing Gear	- TRICYCLE-FIXED	Number Engines	- 1	Stall Warning System	- YES
Max Gross U t	- 7300	Engine Type	- TURBOFROF		
No. of Seats	- 1	Rated	Four - 600 HP		

-----Environment/Operations Information-----

Weather Data		Itinerary		Airport Proximity	
Wx Briefing	- NO RECORD OF BRIEFING	Last Departure Point		OFF AIRPORT/STRIP	
Method	- N/A	SAHE AS ACC/INC			
Completeness	- N/A	Destination		Airport Data	
Basic Weather	- VMC	LOCAL		WEST WIND SPORT PARACHUTE	
Wind Dir/Speed	- UNK/NR	ATC/Airspace		Runway Ident	- 16
Visibility	- 7.0 SM	Type of Flight Plan	- NONE	Runway Lth/Wid	- 3170
Lowest Skw/Clouds	- CLEAR	Type of Clearance	- NONE	Runway Surface	- GRASS/TURF
Lowest Ceiling	- NONE	Type Appch/Lndg	- NONE	Runway Status	- DRY
Obstructions to Vision	- NONE				
Precipitation	- NONE				
Condition of Light	- DAYLIGHT				

-----Personnel Information-----

Pilot-In-Command	Age - 35	Medical Certificate	- VALID HFDICAL-NO WAIVERS/LIMIT
Certificate(s)/Rating(s)	Biennial Flight Review	Flight Time (Hours)	
ATP	Current - UNK/NR	Total	- 4907
SE LAND, ME LAND	Months Since - UNK/NR	Make/Model	- UNK/NR
HELICOPTER	Aircraft Type - UNK/NR	Instrument	- 373
		Multi-Enr	- 3734
		Last 24 Hrs	- UNK/NR
		Last 30 Days	- UNK/NR
		Last 90 Days	- UNK/NR
		Rotorcraft	- 153

Instrument Rating(s) - AIRPLANE

-----Narrative-----

AS THE FLT # 16 JUMPERS DEFTD ON A SKYDIVING FLT, THE ENG LOST FWR AT APRX 300' AGL. THE ACFT THFN RANKEU STEEPLY LEFT, SPIRALED IN A STEEP NOSE DUN ATTITUDE & CRASHED, AN EXAH REVEALED FUEL IN THE TANKS WAS CONTAMINATED WITH UTR & FOREIGN MATERIAL WITH THE APPEARANCE OF BROWN ALGAE. HILKY FLUID (APRX 65% JET FUEL & 34% WTR) WAS FND IN THE ENG FUEL CONTROL, AS UELL AS IRON CONTAHINANTS, DARK STRINGY MATERIAL WAS FND IN THE FUEL FILTERS, THE ACFT HAD BEEN REFUELED FM 55 GAL DRUHS UHICH CONTAINED CONTAMINATED FUEL. THE DRUMS WERE STORED UPRIGHT & RAIN UATER COULD LEAK THRU THE FILLER CAFS. N551CC HAD A HISTORY OF FUEL CONTAMINATION WHICH ON OCCASIONS CAUSED THE FUEL BYPASS INDICATOR TO DISPLAY. RPRTDLY, THE STALL WARNING CIRCUIT BRKR HAD BEEN DISENGAGED ON OTHER OCCASIONS, SO AS NOT TO STARTLE THE JUMPERS; HOWEVER, DUE TO DMG, ITS FREIHPACT FSN COULD NOT BE VERIFIED. ACFT WAS ESTD TO BE 370 LBS OVR ITS MAX UT LHT & 1' FWD OF THE CG LHT. THE 9 PAX SEATS HAD BEEN RMVD TO HAUL UP TO 18 JUMPERS. PAX SEAT BELTS WERE NOT USED. LACK OF FAA SURVEILLANCE UAS NOTED.

Brief of Accident (Continued)

File No. - 1664

9/29/85

JENKINSBURG,GA

A/C Reg. No. N551CC

Time (Lcl) - 1230 EDT

Occurrence #1 LOSS OF POWER(TOTAL) - NON-MECHANICAL
Phase of Operation TAKEOFF - INITIAL CLIME

Findings(s)

1. MAINTENANCE,SERVICE OF AIRCRAFT - IWPROPER - COMPANY/OPERATOR MGMT
2. FUEL SYSTEM - CONTAMINATION
3. FUEL SYSTEM,FILTER - BLOCKED(PARTIAL)
4. OPERATION UITH KNOUN DEFICIENCIES IN EQUIPMENT - FERFORHED - COMPANY/OPERATOR MGMT
5. INADEQUATE SURVEILLANCE OF OPERATION - FAA(ORGANIZATION)
6. FLUID,FUEL - CONTAMINATION
7. FLUID,FUEL - UATER

Occurrence #2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation MANEUVERING - TURN TO LANDING AREA (EMERGENCY)

Findings(s)

8. AIRCRAFT UEIGHT AND BALANCE - EXCEEDED - PILOT IN COMMAND
9. ELECTRICAL SYSTEM,CIRCUIT BREAKER - NOT ENGAGED
10. WARNING SYSTEM(OTHER) - DISABLED
11. INPROPER USE OF PROCEDURE - PILOT IN COMMAND
12. AIRSPEED - NOT MAINTAINED - PILOT IN COMMAND
13. STALL - INADVERTENT - PILOT IN COMMAND
14. SPIRAL - INADVERTENT - PILOT IN COMMAND

Occurrence #3 IN FLIGHT COLLISION UITH TERRAIN
Phase of Operation DESCENT --UNCONTROLLED

Findings(s)

15. SEAT B E L T - NOT USED - PASSENGER

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are findings(s) 1,4,6,7,12,13,14

Factor(s) relatins to this accident is/are findings(s) 2,5,9,10,11

2

3



National
Transportation
Safety Board

Washington, D.C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No.:	DCA 86AAOll
Aircraft Operator:	British Airways
Aircraft Type:	Boeing 747-136
Aircraft Registration:	G-AWNE
Location:	Logan International Airport Boston, Massachusetts
Date:	December 15, 1985
Time:	1450 Eastern standard time
Occupants on Board:	269
Injuries:	None
Aircraft Damage:	Substantial
Type of Occurrence	Component/system failure/malfunction
Phase of Operation:	VFR final approach

On December 15, 1985, British Airways, flight 215, operating under 14 CFR Part 129 as a scheduled foreign air carrier flight, was making an approach to runway 22L at Logan International Airport in Boston, Massachusetts. Shortly after the flightcrew selected full flaps (**30°**), a loud noise was heard and the airplane started to roll to the left. Significant aileron deflections were required to stabilize the aircraft, but the landing was made without further incident.

Readout of the Digital Flight Data Recorder (**DFDR**) indicated that shortly after the wing flaps had reached the **30°** down position, the control wheel position changed from about 0 percent to 50 percent right wing down, and the rudder pedal position changed from 17 percent left rudder to approximately 10 percent right rudder. The altitude was 1,600 feet and the airspeed was 160 knots. 1/ Maximum airspeed for flap extension to **30°** is 180 knots.

Inspection of the airplane revealed that about 16 feet of the left inboard trailing edge **foreflap** separated from the airplane in two sections. The larger section, which struck the roof of a house and an unoccupied car but caused no injuries, was recovered in Revere, Massachusetts. 2/ The smaller section was not recovered. Eight bolts secured the forward attachment-fitting of the No. 3 flap track 3/ to the wing structure. These eight bolts had fractured, and one of the two bolts that **attach** the aft portion of the track to the rear spar had a nut missing. The nut was later found inside the flap track fairing.

The exhaust plug (tail cone) and the 30-pound tip weight from the No. 3 engine were also missing. These components were not recovered. Examination disclosed extensive peening on the interior lower surface of the exhaust plug section that remained with the engine. There was no evidence to suggest that the loss of the exhaust plug and the separation of the trailing edge **foreflap** sections were related, and no associated damage to the right trailing edge flaps was apparent.

1/ See attachment 1.

2/ About 4 nautical miles northeast of the runway threshold.

3/ See attachments 2 and 3.

The airplane, British registration G-AWNE and manufacturer's serial number 19765, was manufactured and delivered to British Airways in 1972, and had been in service with the airline since that time. At the time of the accident, G-AWNE had accumulated 55,667 hours and 13,771 cycles. The aircraft maintenance records revealed that the eight forward attachment bolts for the No. 3 flap track had been undisturbed since manufacture, while the two rear spar attachment bolts were refitted on April 1, 1973, when the grease collar was added. No specific maintenance action for the forward attachment bolts was detailed in the maintenance manual; however, the fuse link that connects the forward end of the flap track to the forward attachment fitting was lubricated at each maintenance check interval of 4,600 hours. The last maintenance check was accomplished 2,240 hours before the accident. The rear spar attachment bolts were lubricated at **1,650-hour** intervals, the last being accomplished on October 20, 1985.

Eight bolts secure the forward attachment fitting of the No. 3 flap track to the lower wing skin and a shear tie rib in the No. 2 fuel tank. They are arranged longitudinally in two rows of four. The four bolts in the forward and aft corners are **7/16** inch in diameter, manufactured to Boeing specification **BACB30MT7T28**, while the four middle bolts in the pattern are **1/2** inch in diameter, manufactured to Boeing specification **BACB30MT8T28**. All of the bolts are made of H-11 steel alloy, which has low fracture toughness and is, therefore, susceptible to failure with small cracks. When the attachment fitting is installed on the wing, the bolts are oriented vertically with the heads down and the washers and self-locking nuts up. Inside the No. 2 fuel tank, **3/4** installation torque is 440 inch-pounds for the **7/16-inch** diameter bolts and 580 inch-pounds for the **1/2** inch diameter bolts.

The Safety Board's metallurgical laboratory examined the No. 3 flap track forward attachment fitting and hardware, with the exception of one bolt head that was sent to the United Kingdom for examination, and the inboard nut and bolt from the aft attachment position, which were not significantly damaged. Examination of the forward fitting components revealed areas of fretting on the upper surface of the fitting. Fretting was particularly heavy on the forward portion of the fitting and between the **aftmost** bolt holes. Corresponding areas of fretting were found on the shims **that** space the fitting from the **wing's** lower surface. In addition, wear or heavy contact was found on the inboard edge of the spherical bearing.

Examination of the eight fractured bolts associated with the forward fitting showed that **three** failed from gross overstress. One of these three bolts was located third aft in the outboard row, and the other two at the two **aftmost** bolt holes. No evidence of preexisting cracking was found on these three bolts.

Examination of the remaining five bolts revealed similar fracture surface features. On **all** of these bolts, the fracture features emanated from the aft side of the bolt, as installed on the airplane, between the bolt head and shank. Examination of the fractures with a scanning electron microscope revealed flat, crescent-shaped fracture regions containing features typical of fatigue cracking. The fatigue zones emanated from multiple origins and progressed a short way into the bolt before separation. This fatigue cracking and fretting on the fitting indicated that the bolts were loose or undertorqued. Fracture features beyond the fatigue zones consisted of a mixture of ductile dimples and what appeared to be intergranular features, consistent with an overstress region stemming from the fatigue zones. The examination also indicated that the bolts met the specifications for dimensions, material, finish, and strength.

3/ Attachment I is an illustration of the flap attach fitting and bolt installation.

Two bolts attach the No. 3 flap track to the rear spar at the aft mount position. The inboard bolt was cut in two places to facilitate its removal from the wing. Bench binocular microscopic examination of the threads on the inboard bolt revealed that they were stripped. Damaged threads near the grip of the bolt indicated that the nut had been installed over most of the threads at the time the threads were stripped. The threads on the nut were stripped also.

The metallurgical examination suggests that the forward attachment fitting separated from the lower surface of the wing and moved downward and outboard as a reaction to **airloads** on the flap, stripping the nut from the rear inboard attachment bolt. The flap track forward attachment fitting is subject to cyclic loads during the normal operation of the airplane. A load is transmitted to the wing through the eight attachment bolts when the flaps are extended during flight, and the load increases with increased airspeed or flap extension.

Disassembly of the No. 3 engine disclosed a broken Low Pressure Turbine (**LPT**) tie bolt. The turbine case was cracked just aft of the last turbine stage from about the 1 o'clock to the 5 o'clock position, viewed looking forward. Extensive peening and punctures of the exhaust plug were noted at the 6 o'clock position immediately forward of the plug fracture. The, 54-inch section of the cone that separated and the 30-pound tip weight were not recovered.

On December 18 and 20, 1985, Boeing telegraphed all operators, recommending that the forward attachment fitting bolts on all 747 airplanes (except -SP models) be inspected for looseness. Boeing also provided instructions and corrective actions if loose bolts were found.

The following actions were taken as a result of the investigation and recommendations made by the Safety Board.

On January 9, 1986, the Safety Board issued Safety Recommendations A-86-1 through -3 to the Federal Aviation Administration (FAA) based on the metallurgical examination of the forward attachment fitting assembly. These recommendations asked the FAA to:

A-86-1

Issue an Airworthiness Directive to require an immediate inspection of all Boeing 747 airplanes having an appropriate minimum number of operating cycles to verify that all bolts for the Nos. 1 through 3 and Nos. 6 through 8 flap track forward attachment fittings are torqued adequately. If any of the bolts are broken or are not torqued adequately, all of the bolts from the forward attachment fitting with the broken or undertorqued bolt should be removed and inspected by an FAA-approved method and the bolts for the other attachments of the affected flap track should be inspected for adequate torque before further flight.

A-86-2

Based on information gained by the inspection program detailed in Safety Recommendation A-86-1, determine an appropriate interval for checking the bolt torque, and define periodic reinspection requirements in an Airworthiness Directive.

A-86-3

Notify foreign governments with operators of Boeing 747 airplanes of the circumstances of the accident involving the British Airways Boeing 747-136 on December 15, 1985, in Boston, Massachusetts, and of any action taken as a result of the accident.

British Airways has inspected all of their Boeing 747 airplanes for looseness in the forward attachment fitting bolts as recommended by Boeing. Three airplanes had loose bolts. One airplane with 56,000 flight hours had two rear spar track attachment bolts loose, the No. 1 inboard and the No. 6 outboard; a second airplane with 57,000 flight hours had four loose bolts in the No. 3 flap track forward attachment fittings; a third airplane with 25,300 hours had one loose bolt at the forward fitting on track No. 8.

Inspections by nine other operators revealed that 12 out of 74 airplanes had from one to eight loose or fractured bolts in any one forward attachment fitting. These airplanes had accumulated between 11,700 and 63,200 flight hours and between 4,080 and 15,500 cycles.

On February 21, 1986, Boeing issued Service Bulletin (SB) **747-57A2234**. In it, Boeing specified its final inspection requirements and corrective actions for the forward flap track attachment fittings. These included replacement of the H-11 bolts with Inconel bolts as they become available.

On April 3, 1986, the FAA responded that a Notice of Proposed Rulemaking (NPRM) would be issued before April 15, 1986, proposing an Airworthiness Directive to require incorporation of SB **747-57A2234** on all 747 airplanes except the -SP models. Such an NPRM was published in the April 7, 1986, Federal Register.

On April 3, 1986, September 12, 1986, and March 31, 1987, the Federal Aviation Administration responded to Safety Recommendations A-86-1, -2 and -3.

With regards to Recommendation A-86-1, the FAA issued Airworthiness Directive AD-86-16-08, Amendment 39-5386, effective September 11, 1986, which required an inspection for loose or failed bolts used for the forward attachment of the numbers 1, 2, 3, 6, 7, 8, trailing edge flap tracks. Compliance was required prior to accumulating 5,000 flight cycles, or within the next 300 flight cycles after the effective date of the AD. This recommendation is considered "**Closed—Acceptable Action.**"

With regards to Recommendation A-86-2, the Safety Board asked FAA to reconsider its position, which did not include repetitive inspections of the flap track bolts. To support their position, FAA found that prior to 1982, the procedure to install the flap assembly required only an initial torquing of bolts. When the bolts were torqued, uncured sealant would be pressed from the mated parts with a loss of the benefit of the original torquing pressure. In 1982, Boeing instituted several changes in the assembly procedures one of which included a requirement to allow a specific time period after initial torquing for the sealant to properly harden. The bolts were then retorqued. The new procedure would allow the bolts to maintain their original torque value. This new procedure was incorporated in the Airworthiness Directive (AD), thus eliminating a requirement for subsequent retorquing. The FAA believes that compliance with the requirements of AD 86-16-08, combined with routine inspections, provides adequate control over the status of the flap track fitting to the wing. (Note: the British Airways airplane involved in the accident was delivered February 1971 before the new installation procedure was incorporated into the manufacturing process that required sealant curing and retorquing.)

In addition, a revision of one of the service bulletin issued on October 16, 1986, relaxed the bolt replacement thresholds. Replacement of loose bolts is no longer required provided they are retightened to the installation torque. Replacement of one or two broken bolts in any one fitting can now be deferred for up to 1,200 flights provided any loose bolts found are retightened to the installation torque prior to further flight. The revision also introduced a 15-month repeat inspection for any replaced or retightened H 11 bolts until Inconal bolts are fitted. As a result of these three actions, compliance with AD 86-16-08, routine inspection requirements and revision one (1) to the original service bulletin, recommendation A-86-2 is considered "Closed-Acceptable Action."

With regards to Safety Recommendation A-86-3, as a result of the Safety Board's recommendation, the FAA informed all foreign operators of the Boeing 747 airplane by providing them with the AD that was sent to all domestic operators. Action on this recommendation A-86-3 is considered "~~Closed~~—Acceptable Action."

The attached brief contains the Safety Board's findings of probable cause relating to this accident.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

May 14, 1987

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident/Incident

File No. - 6003 12/15/85 ROSTON, MA A/C Rrs. No. GAWNE Time (Lcl) - 1450 EST

-----Basic Information-----

Type Operating Certificate-AIR CARRIER - FLAG/DOMESTIC	Aircraft Damage	Injuries			
Name of Carrier -BRITISH AIRWAYS	SUBSTANTIAL	Fatal	Serious	Minor	None
Type of Operation -SCHEDULED, INTL, PASSENGER	Fire	0	0	0	17
Flight Conducted Under -14 CFR 129	NONE	Crew Pass	0	0	0
Acc/Inc Occurred During -APPROACH					252

-----Aircraft Information-----

Make/Model - BOEING 747-136	En s Make/Model - P&W JT9D-7A	ELT Installed/Activated - NO -N/A
Landing Gear - TRICYCLE-RETRACTABLE	Number Engines - 4	Stall Warning System - YES
MAX Gross Wt - 734000	Engine Type - TURBOFAN	
No. of Seats - 413	Rated Power - 46250 LBS THRUST	

-----Environment/Operations Information-----

Weather Data	Itinerary	Airport Proximity
Wx Briefing - COMPANY	Last Departure Point	OFF AIRPORT/STRIP
Method - IN PERSON	LONDON	
Completeness - WEATHER NOT PERTINENT	Destindtion	Airport Data
Basic Weather - vnc	SAME AS ACC/INC	LOGAN INT'L
Wind Dir/Speed- 230/014 KTS	ATC/Airspace	Runway Ident - 22L
Visibility - 15.0 SK	Type of Flight Plan - IFR	Runway Lth/Wid - 10005/ 150
Lowest Sky/Clouds - CLEAR	Type of Clearance - IFR	Runway Surf dce - ASPHALT
Lowest Ceiling - NONE	Type Arch/Lnds - ILS-COMPLETE	Runway Status - DRY
Obstructions to Vision- NONE		
Precipitation - NONE		
Condition of Light - DAYLIGHT		

-----Personnel Information-----

Pilot-In-Command	Ade - 49	Medical Certificate - VALID HFDICAL-NO WAIVERS/LIMIT
Certificate(s)/Rating(s)	Biennial Flight Review	Flight Time (Hours)
ATP	Current - YES	Total - 6481
ME LAND	Months Since - 1	Make/Model- 645
	Aircraft Type - 747	Instrument- UNK/NR
		Multi-En9 - UNK/NR
		Last 34 Hrs - 7
		Last 30 Days- 38
		Last 90 Bays- UNK/NR
		Rotorcraft - UNK/NR

Instrument Rating(s) - AIRPLANE

-----Narrative-----

AFRX 16 FT OF THE LEFT INBOARD TRAILING EDGE FLAP SEPARATED WHILE THE ACFT WAS ON FINAL AFCH TO LAND. THE AFCH AND LANDING WERE COMPLETED WITHOUT FURTHER INCIDENT. INVESTIGATION REVEALED 5 OF THE 8 BOLTS WHICH HOLD THE NO. 3 FLAP TRACK FORWARD ATTACH FITTING TO THE WING SHOWED SIGNS OF FATIGUE AND THE 3 REMAINING BOLTS SHOWED OVRLOAD TYPE FAILURES. NO INSPECTION REQUIREMENTS FOR THE FORWARD ATTACHMENT BOLTS WERE REQUIRED BY BOEING AT THE TIME OF THE ACCIDENT,

Brief of Accident/Incident (Continued)

File No. - 6003

12/15/85

BOSTON, MA

A / C Reg. No. GAWNE

Time (Lcl) - 1450 EST

Occurrence AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation APPROACH - VFR PATTERN - FINAL APPROACH

Finding(s)

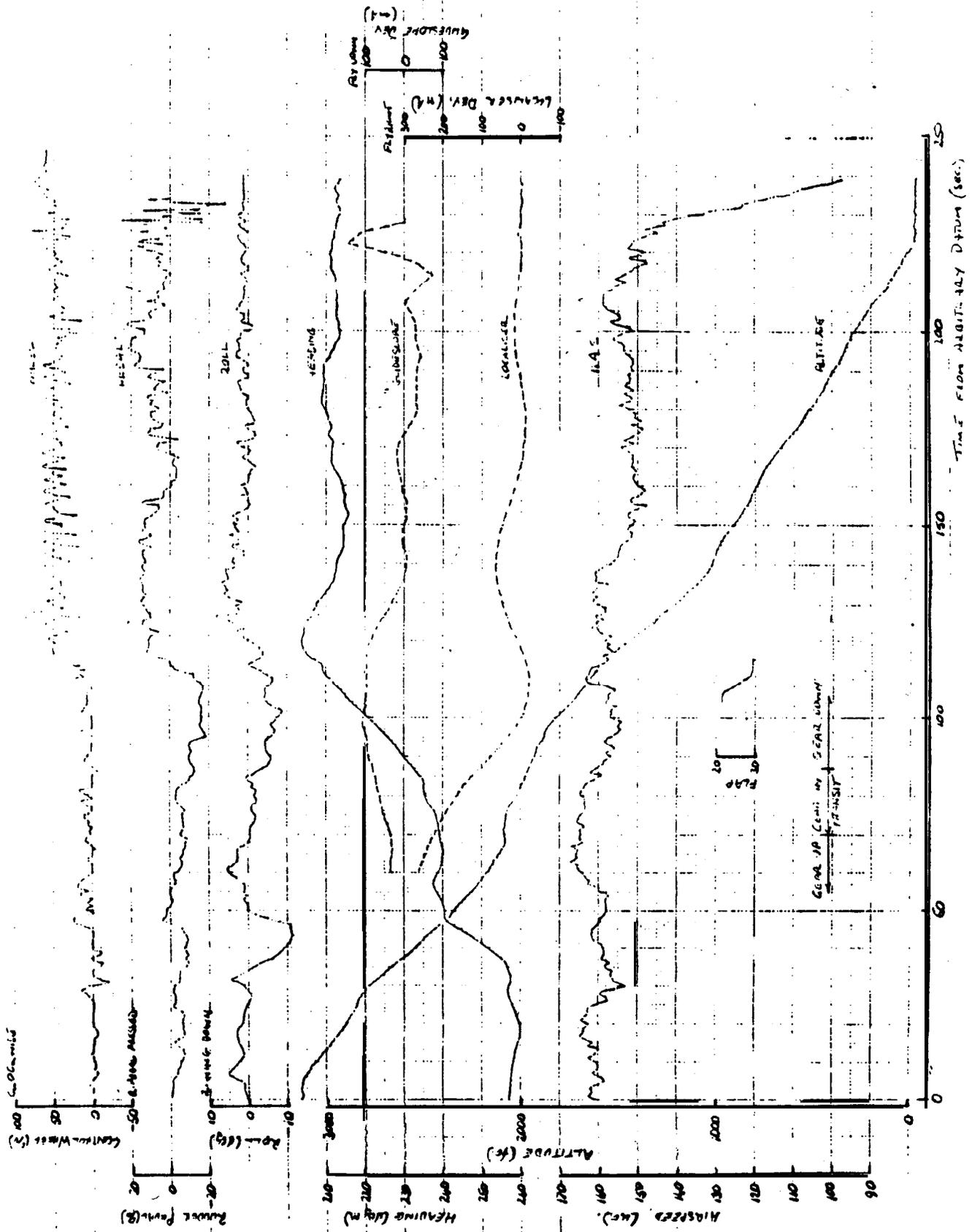
1. FLIGHT CONTROL, FLAP ATTACHMENT - FAILURE, PARTIAL
2. FLIGHT CONTROL, FLAP ATTACHMENT - FATIGUE
3. AIRCRAFT/EQUIPMENT, INADEQUATE DESIGN (STANDARD/REQUIREMENT), AIRFRAME - MANUFACTURER
4. INSUFFICIENT STANDARDS/REQUIREMENTS, MANUFACTURER - MANUFACTURER
5. MAINTENANCE - INADEQUATE - MANUFACTURER
6. MAINTENANCE, INSPECTION OF AIRCRAFT - INADEQUATE - MANUFACTURER

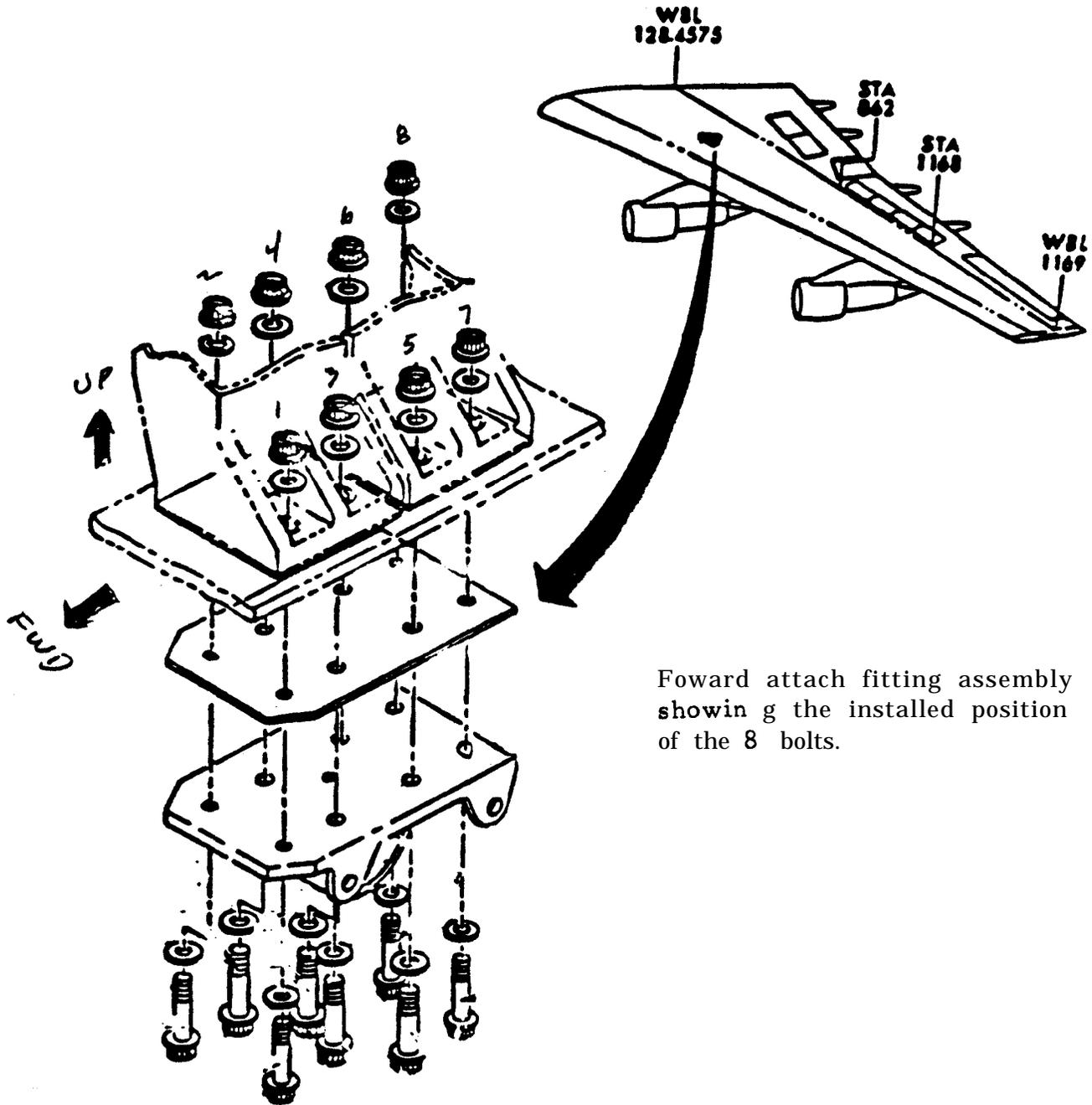
-----Probable Cause-----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident/incident is/are finding(s) 2

Factor(s) relating to this incident is/are finding(s) 1,3,4,5,6

BRITISH AIRWAYS B.747 3-4-76 DEPART AT 00:11N 21 FEBRUARY 1985





Forward attach fitting assembly showing the installed position of the 8 bolts.

ENGR.	REVISED	DATE	
CHECK			
APR			
APR			
			BOEING

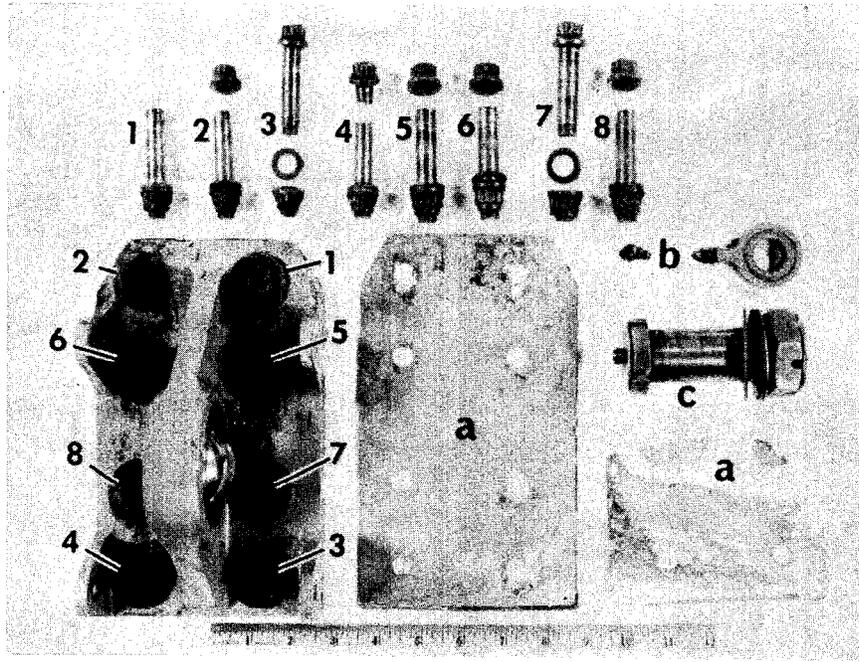


Figure 1. Overall view of the forward attachment fitting components, including the fitting shims (a), grease fittings (b) and the spherical bearing bolt and nut (c).



Figure 2. View of the top face of the No. 3 flap track forward attachment fitting.



AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No.: DCA-86-AA-012
Aircraft Operator: Rick Nelson
Registered Owner: Century Equipment, Inc.
Aircraft Type: Douglas DC-3
Aircraft Registration: N711Y
Location: Near DeKalb, Texas
Date: December 31, 1985
Time: 1714 central standard time 1/
Persons on Board: 9
Injuries: 7 fatal, 2 serious
Aircraft Damage: Destroyed
Other Damage: Minor property damage
Type of Occurrence: Fire
Phase of Operation: Inflight

On December 31, 1985, about 1300, a Douglas DC-3 (N711Y) registered to Century Equipment Company and operated by entertainer Rick Nelson, departed Guntersville, Alabama, on an instrument flight rules flight plan to Love Field in Dallas, Texas. The crew had arrived at the Guntersville airport between 0830 and 0900. The airplane was serviced under the direction of the crew, who then loaded the passengers' personal luggage and musical equipment. About 1240, the crew and passengers boarded N711Y and the airplane taxied for takeoff.

The airplane was occupied by a captain, a copilot, Mr. Rick Nelson, his fiancée, and five members of the Stone Canyon Band. The airplane had been operated on tours for the entertainers in a series of concert engagements. On December 28, 1985, the airplane, the crew, Mr. Nelson, his fiancée, and the five band members had arrived in Guntersville, where the band performed on December 29 and 30, 1985. The group was scheduled to perform in Dallas on New Year's Eve.

At 1708, while operating in daylight visual meteorological conditions, the flight contacted Fort Worth Air Route Traffic Control Center, stating, "I think I'd like to turn around, uh, head for Texarkana here, I've got a little problem." Several communications between the airplane and the Center were made regarding the heading and distances to various airports where the

1/ All times contained herein are central standard time based on the 24-hour clock.

flight could land. At 1711, one of the pilots of N711Y transmitted, "...smoke in the cockpit, have smoke in the cockpit." No further transmissions were received from the flight. At 1712, the air traffic control radar showed an altitude of 600 feet above the ground, and at 1714, radar contact was lost.

Several witnesses observed the final portion of the flight. They stated that the airplane flew a left descending turn from the south and lined up with a farm field in a westerly direction. They all observed smoke trailing from the airplane. Some witnesses observed small grass fires that ignited along the flightpath from falling pieces of hot metal. The airplane flew over a house, struck and severed two power lines about 30 feet above the ground, and then landed gear down in a field.

After the airplane came to rest, the pilot and copilot escaped through their respective cockpit windows. None of the passengers escaped, and the airplane was destroyed by fire. According to witnesses who arrived on scene, the fire was initially centered in the right side of the cabin area, and it then spread and consumed the entire fuselage and cockpit. Portions of the wings, and the vertical and horizontal stabilizers were not destroyed.

The pilots escaped with serious injuries, and the seven passengers died from fire. The Dallas Medical Examiner reported the cause of the passengers' deaths as smoke inhalation and thermal burns. Toxicological analyses for the pilots were negative for alcohol and drugs.

The twin-engine Douglas DC-3, N711Y, was manufactured and certificated as a military C-47 in 1944. The airplane was equipped with an aft passenger/crew entrance door on the left hand side aft of the wing, and had an emergency exit over each wing. In 1959, the airplane was converted from a C-47 to a DC-3C and its interior was refurbished and equipped with an executive interior, which included 14 passenger seats (4 single seat units, 2 double seat units, and 2 triple seat divans), and 2 crew seats. The airplane was not pressurized, but contained two supplemental oxygen systems, one for the cockpit crew and one for use by passengers.

The airplane had two gasoline heaters; one for heating the cockpit and one for heating the cabin. The cabin heater was located aft of the lavatory on the right side of the fuselage. Both heaters were controlled from the cockpit. The cabin heater was equipped with two fire extinguishers, which were activated manually from the heater area. A hand-held portable fire extinguisher was located in the cockpit. The airplane was also equipped with engine fire extinguishers.

N711Y was registered on March 13, 1981, to Century Equipment Company of Los Angeles, California. The airplane was sold to Rick Nelson (Eric Hilliard Nelson) on May 2, 1985, but was never re-registered with the FAA as required by regulations.

The Safety Board's investigation into the events that led to the fire was based primarily on examination of the wreckage of the airplane and statements of the pilots.

Examination of the wreckage eliminated the engines as a cause of the fire. Molten metal globules and charred control surface fabric recovered along the airplane's flightpath were from the airplane's aft lower fuselage structure and from the right elevator control surface. Although the fuselage was virtually destroyed by the ground fire, the most severe damage was concentrated on the right side of the aft fuselage above and below the cabin floor. The cabin heater is located in this area. The heater was examined in place and then was removed for detailed examination at the Safety Board's laboratory.

The on-scene examination did not conclusively prove that the source of the fire ignition was in the cabin heater or in any of the other airplane systems. Several of the fasteners on the cabin heater maintenance access panel were found undone. A hole was found in the heater cold air duct and varying degrees of heat damage were found on the fire shield. Two rubber connections on the heater fuel lines were melted, as were several electrical connections.

The subsequent disassembly and detailed examination of the cabin heater at the laboratory also failed to reveal any ignition source for the fire. Many of the electrical and fuel components associated with the heater were destroyed by the fire; therefore, the heater could not be conclusively ruled out as the fire source.

The captain's and copilot's sworn testimonies regarding the events of the flight, particularly regarding the operation of the cabin heater, were contradictory. Their statements also disagreed concerning crew action prior to, and just after, the onset of the fire. The lack of surviving passengers precluded resolution of some of these contradictions.

The captain stated that during the flight he left the cockpit to check on the passengers and see to their needs. He said that while standing in the cabin, he noticed smoke in the area occupied by Mr. Nelson and his fiancée. Instead of investigating that smoke, the pilot stated that he went through the baggage compartment to the cabin heater. He said that the heater fire shield was cool to his touch, and that he saw

neither smoke nor fire near the heater. However, he said that he did activate one of the two fire extinguishers attached to the heater. He then left the heater area, and moved through the cabin, opening the cabin fresh air inlets on his way back to the cockpit. He said that he directed a passenger to open others. When the captain reached the cockpit and took his seat, he said that the copilot had already begun communications with air traffic control relative to the location of the nearest airports. The captain opened his cockpit window, after which, he said "things rapidly got worse... I started a slow descending turn... and the window was open, and from there, things went completely blacked out. The smoke came through the cabin... it stained the windows, the cockpit glass, everything..."

The captain stated that vision inside the cockpit was so badly obscured that he could not see through the forward windows to land the airplane. He leaned through the opened cockpit window to obtain sufficient visual references to select a landing site, achieve the desired pitch attitude, and land the airplane.

He said that after the airplane rolled to a stop, he exited the airplane through his cockpit window. He said that he opened the aft passenger entrance door and ascended the stairs to look into the cabin. He said that he could see in the smoke and that there was a small flame or fire in the area where he had originally seen smoke when he visited the cabin earlier. The passengers did not respond to his calls so he abandoned the airplane to search outside for his employer and the other passengers.

In contrast, the copilot testified that after the flight was airborne, the cabin heater began to "act up." He said that the overheat light would come on in the cockpit, the crew would turn the heater off, wait for awhile, and then turn the heater back on again. According to the copilot, "At some point, ...Brad (the captain) decided to go aft of the tail to see if there was anything he could do to get it to function correctly... there were several times involved here...he ... signaled for me to turn it on or he ... came up front and told me to turn it on or whatever. This happened several times. One of the times I refused to turn it on, I didn't turn it on. I was getting nervous. I didn't think that we should be messing with that heater en route. I had discussed this with Brad on previous flights... and he turned it on again... Once, again, it either shut off or the overheat light came on, (it) went through the same cycle... The last time Brad went aft in the tail, he was aft for not very long, came out and signaled me to turn it on again, which I did. Several minutes after that, (a passenger)... came forward to me and said, 'There is smoke back here in the cabin.'" The captain subsequently returned to the cockpit.

After the airplane landed, the copilot stated that he opened the right cockpit window, exited through it, and fell to the ground below. He said "My engine (the right engine) had stopped turning, there was no flame on the outside of the airplane on my side, on the right side of the aircraft... The cabin of the aircraft through the windows appeared to be an inferno. Flames and smoke was all that one could see." The copilot moved away from the airplane, fearing an explosion. He encountered the captain, who sat him on the ground, and the captain said, "Don't tell anyone about the heater, don't tell anyone about the heater..."

While it could not be established that the fire originated in the cabin heater, there is no doubt that the fire did originate in the area of the heater. If the copilot's statement about the repeated attempts to relight the cabin heater are accurate, then the captain's repeated attempts to trouble-shoot and relight the heater apparently resulted in a fire in the area of the heater.

There were other potential ignition sources in the area of the heater, such as airplane electrical wires; however, after examination of these systems, none could be identified as having ignited the fire.

The evidence was equally inconclusive regarding whether the fire originated in the cabin. If the captain's statement about the initial sighting of the smoke, and later fire, near passengers on the right side of the cabin is accurate, then careless smoking or other activity in the cabin may have started the fire. In the absence of corroborating evidence, the Safety Board was unable to determine the source of ignition.

It was quite evident that the captain did not use appropriate methods for the control of the fire once it began. For example, the inflight fire checklist was not used--it required fresh air vents to be closed, and the captain opened them. It also called for the flightcrew and passengers to begin using supplemental oxygen, which was not done. Nor did the flightcrew initiate actions to fight the fire with the hand-held fire extinguisher available to them in the cockpit. While these actions, if taken in a timely manner, may not have prevented the loss of the airplane, they would have enhanced the potential for survival of the passengers.

See attached accident brief for the Safety Board's determination of probable cause and contributing factors.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH I. NALL
Member

May 21, 1987

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 2932 12/31/85 DEKALB, TX A / C Reg. No. N711Y Time (Lcl) - 1714 CST

-----Basic Information-----

Tree Operating Certificate-NONE (GENERAL AVIATION)	Aircraft Damage				
Type of Operation -EXECUTIVE/CORPORATE	DESTROYED	Fatal	Injuries		None
Flight Conducted Under -OTHER	Fire	0	Serious	Minor	0
Occident Occurred During -OTHER	IN FLIGHT	Crew Pass 7	2	0	0

-----Aircraft Information-----

Rake/Model - DOUGLAS DC-3	Eng Make/Model - P&W R-1830-75	ELT Installed/Activated - UNK/NR
Landing Gear - TAILWHEEL-RETRACTABLE MAINS	Number Engines - 2	Stall Warning System - UNK/NR
Max Gross Wt - 26900	Engine Type - RECIPROCATING-CARBURETOR	
NO. of Seats - 16	Rated Power - 1100 HP	

-----Environment/Operations Information-----

Weather Data	Itinerary	Airport Proximity
Wx Briefing - FSS	Last Departure Point	OFF AIRPORT/STRIP
Method - TELEPHONE	GUNTERSVILLE, AL	
Completeness - FULL	Destination	Airport Data
Basic Weather - VMC	DALLAS, TX	Runway Ident - N/A
Wind Dir/Speed- VARIABLE	ATC/Airspace	Runway Lth/Wid - N/A
Visibility - 15.0 SM	Type of Flight Plan - IFR	Runway Surface - N/A
Lowest Sky/Clouds - CLEAR	Type of Clearance - IFR	Runway Status - N/A
Lowest Ceiling - NONE	Type Arch/Lnds - FORCED LANDING	
Obstructions to Vision- NONE		
Precipitation - NONE		
Condition of Light - DAYLIGHT		

-----Personnel Information-----

Pilot-In-Command	Age - 33	Medical Certificate - VALID HEDICAL-NO WAIVERS/LIMIT
Certificate(s)/Rating(s)	Biennial Flight Review	Flight Time (Hours)
COMMERCIAL, ATP, CFI	Current - YES	Total - 5700
SE LAND, ME LAND	Months Since - 7	Make/Model - 150
HELICOPTER	Aircraft Type - DC-3	Instrument - UNK/NR
		Multi-Eng - UNK/NR
		Last 24 Hrs - UNK/NR
		Last 30 Days - UNK/NR
		Last 90 Days - UNK/NR
		Rotorcraft - UNK/NR

Instrument Rating(s) - AIRPLANE

-----Narrative-----

AT 1708:48, WHILE CRUISING AT 6000', A PILOT OF N711Y ADVISED ATC, 'I THINK I'D LIKE TO TURN AROUND, HEAD FOR TEXARKANA HERE, I'VE GOT A LITTLE PROBLEH.' HE WAS PROVIDED A VECTOR & ADVISED OF CLOSEST AIRPORTS. SHORTLY AFTER, HE STATED HE WOULD BE UNABLE TO RERCH THE AIRPORTS. AT 1711:49, HE SAID THERE WAS SHOKE IN THE COCKPIT. WHILE LANDING IN A FIELD AT 1714, THE AIRCRAFT HIT WIRES & A POLE THEN CONTINUED INTO TREES WHERE IT WAS EXTENSIVELY DAHAGED BY IMPACT & FIRE. THE CREW EGRESSED THRU THE COCKPIT WINDOWS. THE PASSENGERS DID NOT ESCAPE. DURING FLIGHT? THE CREW WAS UNABLE TO START THE CABIN HEATER; DESPITE REPEATED ATTEHPPTS BY THE CAPTAIN, SHOKE THEN ENTERED THE CABIN. FRESH AIR VENTS & COCKPIT WINDOWS WERE OPENED, BUT SHOKE BECAME DENSE. THE CREW HAD DIFFICULTY SEEING. THE OXYGEN SYSTEH & HAND HELD FIRE EXTINGUISHERS WERE NOT USED. FASTENERS FOR THE HEATER DOOR WERE FOUND UNFASTENED. EXAMINATION INDICATED THE FIRE ORIGINATED IN THE AFT CABIN AREA, RIGHT HAND SIDE, AT OR NEAR THE FLOOR LINE. THE IGNITION AND FUEL SOURCES WERE NOT DETERHINED.

Brief of Accident (Continued)

File No. - 2932

12/31/85

DEKALB, TX

A / C Reg. No. N711Y

Time (Lcl) - 1714 CST

Occurrence #1 FIRE
Phase of Operation CRUISE

Findings(s)

1. FUSELAGE, CABIN - FIRE
2. UNDETERMINED
3. FUSELAGE, CABIN - SMOKE
4. FUSELAGE, CREW COMPARTMENT - SMOKE
5. EMERGENCY PROCEDURE - NOT FOLLOWED - PILOT IN COHHAND
6. CHECKLIST - NOT USED -
7. OXYGEN SYSTEH - NOT USED -

Occurrence #2 FORCED LANDING
Phase of Operation DESCENT - EHERGENCY

Occurrence #3 IN FLIGHT COLLISION WITH OBJECT
Phase of Operation LANDING - FLARE/TOUCHDOWN

Findings(s)

8. OBJECT - WIRE, TRANSMISSION
9. OBJECT - UTILITY POLE

Occurrence #4 ON GROUND COLLISION WITH OBJECT
Phase of Operation LANDING - ROLL

Findings(s)

10. TERRAIN CONDITION - TREE(S)

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are findings(s) 1,2

Factor(s) relating to this accident is/are findings(s) 3,4,5,6,7,8,9,10



**National
Transportation
Safety Board**

Washington, D.C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No.:	DCA 86-A-A-018
Aircraft Operator:	USAir, Inc.
Aircraft Type:	McDonnell Douglas DC-g-31
Aircraft Registration:	N961VJ
Location:	Erie International Airport, Pennsylvania
Date:	February 21, 1966
Time:	0659 eastern standard time
Occupants on Board:	23
Injuries:	1 minor
Aircraft Damage:	Substantial
Other Damage:	Airport fence and runway end light
Type of Occurrence:	Overrun
Phase of Operation:	Landing

On February 21, 1966, at 0859, 1/ USAir Flight 499, operating under 14 CFR Part 121 as a scheduled passenger flight, landed on runway 24 at Erie International Airport, Erie, Pennsylvania. The airplane failed to stop on the runway, rolled across a snow-covered unpaved area, and came to rest on a road about 180 feet beyond and 20 feet lower than the end of the runway. One passenger received a minor injury; all other passengers and the crewmembers were uninjured. The airplane was severely damaged by impact with the embankments on both sides of the road.

The flight had originated in Toronto, Canada, and was scheduled to fly to Pittsburgh with an **enroute** stop in Erie. The flightcrew reported for duty about 0700 and received a flight information package that included the following:

Destination Weather: Erie (Special) weather at 0650, measured ceiling 300 feet overcast, visibility 1 1/2 miles in light snow and fog, temperature and dew point 32 (degrees F), wind **030°** at 10 knots, altimeter 29.93.

Terminal Forecast: Erie forecast from 0500 until 1700, ceiling 300 feet, sky obscured, visibility 1/2 mile in light snow and fog, wind **010°** at 13 knots; occasional ceiling 800 feet overcast, visibility 2 miles in light snow and fog, chance of light freezing rain and light ice pellets until 0600. By 1100 becoming ceiling 700 feet overcast, visibility 2 miles in light snow, wind **010°** at 15 knots, gusts to 25 knots.

Field Condition Report: Runway 06-24 plowed full length and width, covered with a thin layer of wet snow less than 1/4 inch deep, braking action reported fair to poor by a vehicle, all other paved surfaces covered with 1/2 inch of wet snow, braking action poor, use caution when taxiing.

The flightcrew discussed these reports and the captain noted that the weather was "**not too good.**" They determined that the fuel load was adequate to hold at Erie if the weather was below landing minimums when they arrived. The crew proceeded to the aircraft, accomplished their normal preflight inspection, and departed the gate at 0756, 28 minutes late; the captain was flying the aircraft.

1/ All times in this report are eastern standard time based on a 24-hour clock.

At Erie International Airport, a snowplow operator had begun clearing runway 06-24 about 0400. Only one plow was operational, and it typically left some pavement areas covered with about 1/4 inch of snow. The operator stated that the snow was "wet." He also recalled that he could see the runway surface markings on the portion of the runway that he had just plowed. At 0545, he prepared the first Field Condition Report of the day, which included a report of "poor" braking action. He checked the braking action again about 0715 using a James Brake Decelerometer installed in a pickup truck; it indicated that the braking action was fair to poor. About 0745, a Beechcraft King Air landed on runway 06 and reported to the tower that braking action was "poor." The King Air pilot noted that the runway was covered with approximately 1 to 2 inches of wet snow with no bare spots visible. When the King Air departed about 0815, plowing was in progress and Erie Tower instructed the pilot to hold short of runway 06 until the snowplow exited the runway. Although the left side of the runway had just been plowed, the pilot stated that he could see no bare spots on the runway; he estimated that there was 1/2 inch of snow on the plowed surface. At 0620, anticipating the estimated 0840 arrival of flight 499, the snowplow operator stopped plowing the runway. No surface treatment (sand or urea) was applied to the runway. He stated that a light wind was blowing from the east-northeast, and light snow was falling. The intensity of the snowfall increased just before flight 499 landed. No further plowing was accomplished from 0820 until flight 499 landed, almost 40 minutes later. After the accident, sometime between 1100 and 1200, the runway was plowed again, removing "a good inch" of new snow, according to the plow operator.

Upon arrival in the Erie area, the crew of flight 499 accomplished the preliminary landing checklist and received the latest Automatic Terminal Information Service (ATIS) 2/ information:

Erie information Juliet: 0753, indefinite ceiling two hundred sky obscured, visibility one half mile, light snow and fog. Temperature and dew point 32, wind 010 at 8, altimeter 29.97. ILS 3/ approaches runway 6, plowed full length, thin snow covering. SIGMET K2 in effect." 4/

The crew had planned for an ILS approach to runway 06, but the runway visual range (RVR) 5/ was reported to be 2,800 feet, less than the 4,000 feet required for the approach. Therefore, the captain decided to hold at 10,000 feet and wait for an improvement in the weather. Erie Operations called the system control center in Pittsburgh and advised the dispatcher that flight 499 was holding. The dispatcher checked the current Erie weather and compared the information to the minimum visibility listed on the approach charts. Since the visibility precluded an approach to runway 06, and landing with a tailwind was not allowed on runway 24, the dispatcher told Erie Operations to advise flight 499 to overfly Erie and proceed to Pittsburgh.

During this discussion between the dispatcher and Erie Operations, the captain asked Erie Approach Control if the visibility had improved, and they replied that it had not. At the suggestion of a Customer Service Agent in Erie Operations, the crew then requested clearance for an approach to runway 24, which was not equipped with RVR sensors and

2/ ATIS is the continuous broadcast of recorded noncontrol information including surface weather and approach in use.

3/ Instrument landing system is a precision instrument approach system which provides course and vertical guidance during approach and landing.

4/ Significant Meteorological Information is a weather advisory issued concerning weather significant to the safety of all aircraft. (SIGMET K2 referred to occasional severe turbulence below 10,000 feet but was not relevant to this accident.)

5/ RVR is an instrumentally-derived value that represents the horizontal distance a pilot will see down the runway from the approach end. If available, RVR will be used in lieu of prevailing visibility in determining minimums for a particular runway.

had a required minimum visibility of 1/2 mile, equal to the reported prevailing visibility. Erie Operations advised the dispatcher of the crew's intentions and told him that the crew had stated that the wind was from **330°** at 9 knots. (The crew was unable to recall the origin of this wind report when they were interviewed after the accident.)

The dispatcher advised Erie Operations to tell flight 499 to make only one approach and, if the approach was unsuccessful, to proceed to Pittsburgh. Approach control cleared flight 499 to descend to 2,300 feet and gave vectors to intercept the ILS to runway 24. At that time, Erie tower reported that the wind was variable from 350 to **020°** at 9 knots. At **0834:50**, Erie tower transmitted the latest weather: ". . . weather is indefinite ceiling two hundred, sky obscured, visibility one-half, light snow and fog, temperature and dew point are three-two."

At **0835:21**, Erie Approach Control told flight 499 to maintain 5,000 feet because the tower controllers were unable to switch the ILS from runway 06 to runway 24. FAA technicians found that the cause of the difficulty was an accumulation of 2 to 3 inches of snow on the runway 24 **localizer** antennas; once the snow was removed, the ILS performed within the required parameters and was activated.

At **0838:07**, believing that there would be a long delay before he could attempt an approach, the captain elected to proceed to Pittsburgh. The crew was cleared to climb to 13,000 feet and to proceed on course. At **0844:58**, Cleveland Center notified flight 499 that the ILS was now operating on runway 24, and the captain decided to return to Erie and attempt one approach. At **0855:49**, approach control reported the wind as "variable three five zero to zero two zero at nine . . ." The weather was unchanged, and the visibility was still 1/2 mile. At **0856:41**, flight 499 contacted Erie Tower, and the controller reported the wind to be "010 at 10 knots, runway 24 covered with 1/4 inch of wet snow, braking action reported poor by a King Air." At **0857:16**, the tower transmitted: "USAir 499, that wind's starting to pick up now. That wind is now zero one to zero two zero at one five." (This wind report represents a **tailwind** component on runway 24 of 10 to 11 knots.)

When the flightcrew received these wind reports, the first officer attempted to check the **crosswind/tailwind** component chart, but since the aircraft was below 1,000 feet and on final approach, the captain directed him to put the chart down and assist him by monitoring the approach and making the standard altitude call-outs. At **0857:59**, the tower reported, "Wind check zero one zero at one two."

The first officer said that he made the 500-foot **callout**, noting that the airspeed was about 10 knots above Vref. ^{6/} The flight data recorder (FDR) indicated that an approach speed of 130 to 135 knots, about 13 to 18 knots above Vref, was maintained throughout the final approach. The cockpit voice recorder transcript indicates that the first officer made the 1,000-foot call, but the captain stated, "Comin' out of five hundred." The first officer said he saw the ground about 100 feet above decision height; when the aircraft was 50 feet above decision height (250 feet above the runway elevation), he could see the approach lights but could not define the actual end of the runway. According to the first officer, although the runway lights were visible, he could not see the runway surface because it was covered with snow. He also said that at 50 feet above minimums, the aircraft was on the centerline and glideslope.

^{6/} Vref is reference speed, equivalent to 1.3 times the stall speed for a given gross weight in the landing configuration. Flight 499's Vref was 117 knots.

The FDR showed that the airplane descended to the decision height of 200 feet, and then maintained 200 feet for about 8 seconds before continuing the descent; the aircraft touched down at **0858:30**. Both pilots agreed that the touchdown was firm, but the autospoilers, although armed, did not deploy. The captain stated that he deployed the spoilers manually, lowered the nose, actuated reverse thrust, and applied the brakes. Although he felt the reverse thrust slow the aircraft, he said the brakes were not effective. The **captain increased** reverse thrust to maximum and increased pressure on the brake pedals. The aircraft started drifting slowly to the left as it approached the end of the runway. It departed the runway at a speed of about 44 knots according to the FDR analysis; the copilot estimated their speed as 15 to 20 knots. The airplane ran over a runway end identifier light, struck a chain-link fence, and came to rest on a road about 180 feet beyond and 20 feet below the end of the runway.

As the aircraft came to a stop, the impact opened the cockpit door. The captain looked **back** and directed the flight attendants to evacuate the aircraft. Using the escape slide at the forward entry door, the attendants performed the evacuation in an orderly and prompt manner. The flightcrew secured the cockpit and the captain notified the tower that the aircraft had gone off the end of the runway and requested assistance. The pilots left the aircraft and, after inspecting it for fuel leaks and not finding any, were driven to the airport terminal by the **USAir** station manager. The flight attendants escorted the passengers to a nearby building, where they stayed until they were transported to the terminal. One passenger bumped her head and sustained a minor injury as the aircraft came to rest; the other passengers and crewmembers were uninjured.

The navigational aids used for the approach were flight-checked after the accident and were found to be operating satisfactorily. Air traffic control (ATC) personnel were properly qualified; the controllers handled the flight in accordance with current ATC procedures, and provided all available weather information to flight 499. No mechanical discrepancies were found that could have adversely affected the stopping ability of the aircraft.

The captain had been employed by **USAir** since January 1979. He had a total flying time of 8,900 hours, and had flown 5,900 hours in the **DC-9**, including about 500 hours as pilot-in-command. His last proficiency check was completed satisfactorily 11 days before the accident. He held an airline transport pilot certificate with a DC-9 type rating and a valid first class medical certificate with no limitations or waivers. All records indicated that his performance had been satisfactory throughout his employment.

The first officer had been employed by **USAir** since September 1982. He had a total flying time of 4,880 hours, including 2,420 hours in the **DC-9**. His most recent proficiency check was completed in June 1985. He held an airline transport pilot certificate. His first class medical certificate, with no limitations or waivers, was issued on July 15, 1985. His performance had also been satisfactory throughout his employment at **USAir**.

The **USAir DC-9 Pilots' Handbook**, Erie Airport Analysis Page, states that landing is not authorized on runway 24 with any **tailwind** if the runway is wet or slippery. Furthermore, page 10-7 of the Jeppesen Route Manual, **USAir Airport Advisory**, contains this statement about Erie: "**Tailwind Restriction: Tailwind** components are not authorized for turbojet equipment on Runway 24 with wet/slippery conditions." (Erie runway 24 is one of five runways on **USAir's** route system that are similarly restricted.)

The crew of flight 499 received at least four weather reports and/or wind checks that indicated that they would be landing with a **tailwind** component. The fact that they were checking their crosswind/tailwind component chart shows that they overlooked the restriction that prohibited landing on runway 24 with any **tailwind** component.

When interviewed' after the accident, the **captain** stated that:

...because of the existing weather conditions, the previously fluctuating winds, the prelanding workload and the proximity of the aircraft to the ground, the nature of the (wind) advisory may not have been fully comprehended at the time.

The following information concerning winds, braking action, and runway conditions is found in the USAir DC-9 Pilot's Handbook:

Maximum 90 degree Crosswind Component for Landing when Visibility is less than 3/4 mile or RVR 4000 if runway is less than 9,000 feet: 10 knots.

Poor Braking Action: Very careful planning, judgment, and execution are absolutely essential. Crosswind becomes a "priority one" consideration. While a safe and successful approach, landing, and stop can be accomplished if all factors are favorable, there is little room for error. Care must be exercised in every facet of the operation and a very careful evaluation of all existing conditions is necessary.

Monitor spoilers when landing on slippery runways since the spoilers automatically deploy only with wheel spin-up or when the nosewheel is on the ground.

The first 2,000 feet (of landing roll on a slush-covered runway) is the most critical since the airplane tends to hydroplane at high speeds. Wheel braking during this period would be ineffective because the wheels would not be making contact with the runway.

Operating Restrictions for Takeoffs and Landings:

Dry snow- 2 inches

Wet snow- Any amount may halt operations, subject to Captain/SCC (System Control Center) decision.

Slush- 1/4 inch*

*Under conditions considered favorable by the Captain and Dispatcher, operations may continue up to, but not to exceed 1/2 inch. The conditions that must be considered by the Captain and flightcrew are wind direction, velocity, runway of sufficient length, amount of runway covered by the condition, the consistency of the slush, etc.

Wet Snow: Snow with sufficient moisture content so that it packs easily Wet snow quickly becomes slush under certain conditions. If in doubt, be conservative- treat it as slush.

According to eyewitnesses, the aircraft crossed the runway threshold at a higher than normal altitude. One of these witnesses saw the aircraft touch down at a point that was subsequently measured to be 2,130 feet beyond the 500 footdisplaced threshold of the

6,500-foot runway, leaving 3,870 feet of paved surface on which to stop. Calculations using FDR data showed that the airplane touched down 1,745 feet beyond the displaced threshold, leaving 4,255 feet of runway on which to stop.

Other witnesses saw the nose gear make contact with the runway about 3,200 feet beyond the displaced threshold. There was a 7-second interval between main gear and nose gear touchdown, according to the witness statements ⁷⁷ and the FDR analysis. The aircraft would have traveled 1,200 to 1,400 feet in that time. These data confirm an initial touchdown about 1,900 to 2,000 feet beyond the displaced threshold.

Analysis performed by the Douglas Aircraft Company and the Safety Board staff indicated that a distance of 4,087 feet from the point of main gear contact would be required to stop the airplane under the aircraft configuration, weather, and runway surface conditions existing at the time of flight 499's landing. This calculation included the 7-second delay in lowering the nose wheel to the runway. Since the spoilers did not deploy automatically, probably due to the absence of main wheel spin-up, the captain took the time to deploy them manually before lowering the nose, actuating reverse thrust and applying the brakes. If he had lowered the nose immediately, the spoilers would have deployed when the nose wheel strut compressed. Reverse thrust, the most effective means to initially decelerate the airplane, should have been applied immediately after touchdown. If these procedures had been followed, the stopping distance would have been only 2,750 feet, according to the Douglas analysis.

Both of these stopping distances are predicated on a runway covered with 1/4 inch of wet snow, as reported to the crew of flight 499, but other information indicates that the wet snow may have been at least 1/2 inch deep. The runway had not been plowed for almost 40 minutes and during that time snow continued to fall. The departing King Air estimated that there was 1/2 inch of snow on the plowed surface of the runway at 0915, 44 minutes before flight 499 landed. Witnesses agreed that the runway was entirely covered with snow at the time of the accident. Even if the runway was covered with 1/2 inch of wet snow, there would have been no significant change in the previously mentioned stopping distances. Therefore, the Safety Board concludes that, regardless of the depth of the snow, the pilot was unable to stop the aircraft on the remaining runway because of the combined effects of tailwind, excessive approach speed, landing beyond the touchdown zone, poor braking action due to the snow, and improper pilot technique during the landing roll.

The Safety Board believes that USAir provided its flightcrews with adequate information on company policy and procedures for conducting approaches and landings under adverse weather conditions. Although the landing might have been successful if the captain had lowered the nose immediately after touchdown and had applied optimum braking and reverse thrust, company procedures clearly prohibit any attempt to land on runway 24 under the tailwind/surface conditions existing at the time. If the flightcrew had complied with this restriction, the accident would not have occurred. When the flightcrew first decided to attempt an approach to runway 24, they believed that the wind was from 330° at 9 knots, a direct crosswind within one knot of their allowable limit of 10 knots. From then until touchdown, their attention was focused on executing the instrument approach and configuring the airplane for landing. Although they were aware of the existence of the tailwind, they overlooked the company prohibition against landing on runway 24 with any tailwind component under wet/slippery conditions.

⁷⁷ One witness observed the point at which the main gear touched down, and other witnesses saw the nose gear touch down. The distance between these points, when compared to the airplane's ground speed, corresponded to a time interval of 7 seconds.

The dispatcher, accepting the veracity of the crosswind reported by the flightcrew through Erie Operations, gave no further guidance. Since it is not possible for a dispatcher to monitor the minute-by-minute weather changes at the airports under his control, he must defer his share of the joint responsibility for safe conduct of the flight to the flightcrew during those times when local conditions require immediate decisions. Therefore, the Safety Board believes that the dispatcher fulfilled his duties to monitor the conduct of the flight within the limitations of the information available to him during the last few minutes before the accident.

The attached Brief contains the Safety Board's findings of probable cause relating to this accident.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ JIM BURNETT
Chairman

/s/ PATRICIA A. GOLDMAN
Vice Chairman

/s/ JOHN K. LAUBER
Member

/s/ JOSEPH T. NALL
Member

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 1337 2/21/86 ERIE, PA A/C Reg. No. N961UJ Time (Lcl) - 0859 EST

-----Basic Information-----

Type Operating Certificate - AIR CARRIER - FLAG/DOMESTIC	Aircraft Damage	Injuries			
Name of Carrier - US AIR, INC.	SUBSTANTIAL	Fatal	Serious	Minor	None
Type of Operation - SCHEDULED, INTL, PASSENGER	Fire	Crew 0	0	0	5
Flight Conducted Under - 14 CFR 121	NONE	Pass 0	0	1	17
Accident Occurred During - LANDING					

-----Aircraft Information-----

Make/Model - MCDONNELL-DOUGLAS DC-9-31	Eng Make/Model - P&W JT8D-7B	ELT Installed/Activated - NO - N/A
Landing Gear - TRICYCLE-RETRACTABLE	Number Engines - 2	Stall Warning System - YES
Max Gross Wt - 105000	Engine Type - TURBOFAN	
No. of Seats - 110	Rated Power - 14000 LBS THRUST	

-----Environment/Operations Information-----

Weather Data	Itinerary	Airport Proximity
Wx Briefing - COMPANY	Last Departure Point	ON AIRPORT
Method - TELETYPE	TORONTO, CANADA	
Completeness - FULL	Destination	Airport Data
Basic Weather - IMC	SAME AS ACC/INC	ERIE INTL
Wind Dir/Speed - 010/012 KTS	ATC/Airspace	Runway Ident - 24
Visibility - ,500 SM	Type of Flight Plan - IFR	Runway Lth/Wid - 6000/ 150
Lowest Sky/Clouds - 200 FT	Type of Clearance - IFR	Runway Surface - ASPHALT
Lowest Ceiling - 200 FT OBSCURES	Type Apch/Lndg - ILS-COMPLETE	Runway Status - SNOW - WET
Obstructions to Vision - FOG		
Precipitation - SNOW		
Condition of Light - DAYLIGHT		

-----Personnel Information-----

Pilot-In-Command	Age - 37	Medical Certificate - VALID MEDICAL-NO WAIVERS/LIMIT
Certificate(s)/Rating(s)	Biennial Flight Review	Flight Time (Hours)
COMMERCIAL, ATP	Current - YES	Total - 8900
ME LAND	Months Since - 1	Make/Model - 5900
HELICOPTER	Aircraft Type - DC-9-31	Instrument - UNK/NR
		Multi-Eng - UNK/NR
		Last 24 Hrs - 1
		Last 30 days - 39
		Last 90 Days - 180
		Rotorcraft - UNK/NR

Instrument Rating(s) - AIRPLANE, HELICOPTER

-----Narrative-----

DRG ARRIVAL, THE CREW OF US AIRFLT 499 LNDG ON RWY 24, WHICH WAS CVRD WITH SNW. RPRTDLY, WHILE LNDG, THE ACFT TOUCHED DWN APRX 1800 TO 2000' BYND THE DISPLACED THRESHOLD, ALTHO ARMED, THE SPOILERS DID NOT AUTO-DEPLOY, SO THE CAPT OPERATED THEM MANUALLY. HE LOWERED THE ACFT'S NOSE, ACTUATED REVERSE THRUST & APPLIED BRAKES. THF BRAKES WERE NOT EFFECTIVE. SUBSEQUENTLY, THE ACFT CONTD OFF THE END OF THE RWY, RAN OVR A RWY FND ID LGT, STRUCK A FENCE & CAME TO REST STRADDLING A ROAD. THE CREW HAD PLANNED ON MAKING AN ILS APCH TO RWY 6, PUT THE RVR WAS ONLY 2800' & A MIN RVR OF 4000' WAS REQD FOR THAT RWY. THE CREW ELECTED TO LND ON RWY 24, SINCE f/2 MIVIS WAS SUFFICIENT FOR THAT RWY. HOWEVER, THE APCH WAS MADE WITH A QTRG TAIL WND & APRX 10 KTS ABVUREF. TAIL WND LNDGS WERE NOT AUTHORIZED ON RWY 24 IN WET/SLIPPERY CONDS. THE RWY BRAKING ACTION WAS RPRTD AS FAIR-TO-POOR. THE PLT'S HANDBOOK CAUTIONED THE CREW TO MONITOR THE SPOILERS WHEN LNDG ON SLIPPERY RWYS, SINCE THE SPOILERS AUTO-DEPLOY ONLY WITH WHEEL SPIN-UP OR WHEN THF NOSE WHEEL IS ON THE GROUND.

Brief of Accident (Continued)

File No. - 1337

2/21/86

ERIE, PA

A / C Reg. No. N9610J

Time (LCL) - 0859 EST

Occurrence #1 OVERRUN
Phase of Operation LANDING - ROLL

Findings(s)

1. WEATHER CONDITION - LOW CEILING
2. WEATHER CONDITION - SNOW
3. WEATHER CONDITION - FOG
4. WEATHER CONDITION - TAILWIND
5. PLANNING-DECISION - IMPROPER - PILOT IN COMMAND
6. AIRSPEED(VREF) - EXCEEDED - PILOT IN COMMAND
7. AIRPORT FACILITIES, RUNWAY/LANDING AREA CONDITION - DISPLACED THRESHOLD
8. PROPER TOUCHDOWN POINT - NOT ATTAINED - PILOT IN COMMAND
9. AIRPORT FACILITIES, RUNWAY/LANDING AREA CONDITION - SNOW COVERED
10. GO-AROUND - NOT PERFORMED - PILOT IN COMMAND

Occurrence #2 ON GROUND COLLISION WITH OBJECT
Phase of Operation LANDING - ROLL

Findings(s)

11. OBJECT - RUNWAY LIGHT
12. OBJECT - FENCE

Occurrence #3 ON GROUND COLLISION WITH TERRAIN
Phase of Operation LANDING - ROLL

Findings(s)

13. TERRAIN CONDITION - ROUGH/UNEVEN

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are findings(s) 5, 10

Factor(s) relating to this accident is/are findings(s) 1, 2, 3, 4, 6, 7, 8, 9, 11, 12, 13