

NATIONAL TRANSPORTATION SAFETY BOARD

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AIRCRAFT INCIDENT REPORT

EASTERN AIR LINES, INC.

BOEING 727-100, N8168G,

FLIGHT 9701

ATLANTA, GEORGIA

DECEMBER 21, 1971



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Washington, D. C. 20591

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16. Abstract Eastern Air Lines, Inc., Flight 9701, a Boeing 727-100, N8168G, was operated as a regularly scheduled cargo flight on December 21, 1971. At 0405 e.s.t. the flight departed Charlotte, North Carolina, with Atlanta, Georgia, as the destination. The flight en route and in the Atlanta terminal area was routine until after the aircraft passed the outer marker inbound on an instrument landing system, Category II, approach to Runway 9 Right at the William B. Hartsfield Atlanta International Airport. Flight 9701 reported over the outer marker at 0446. Shortly thereafter an alarm in the Atlanta airport tower sounded, signaling that the approach light system was not functioning properly. Subsequently, it was discovered that N8168G had struck the Nos. 18, 17, 16, and 15 light bars of the approach light system before landing on Runway 9 Right. Contact with the approach lights caused minor damage to the left inboard flaps and subsequent blowout of the two left main landing gear tires. The National Transportation Safety Board determines that the probable cause of this incident was an unexpected and undetected divergence of the aircraft from the glideslope centerline induced by a malfunction of the automatic pilot. This divergence occurred at an altitude from which a safe recovery could have been made. However, both the pilot and the first officer were preoccupied at the time with establishing outside visual reference under visibility conditions which precluded adequate altitude assessment from external clues. Consequently, the pilot did not recognize the divergence from the glide-slope in time to avoid contact with the approach lights.					
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WASHINGTON, D.C. 20591
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Adopted: July 26, 1972

EASTERN AIR LINES, INC.
BOEING 727-100, N8168G,
FLIGHT 9701
ATLANTA, GEORGIA
DECEMBER 21, 1971

SYNOPSIS

Eastern Air Lines, Inc., Flight 9701 of December 21, 1971, a Boeing 727-100, N8168G, was a scheduled cargo flight from Charlotte, North Carolina, to Atlanta, Georgia. The flight was routine until the aircraft arrived over the outer marker of the instrument landing system serving Runway 9 Right at the William B. Hartsfield Atlanta International Airport.

An instrument landing system approach to Category II minima was initiated with the automatic pilot and approach coupler engaged. The landing flaps were extended to the 30° position when the aircraft passed over the outer marker. During flap extension, the aircraft deviated from the glide-slope centerline and did not again become stabilized on the glide-slope until it was at an altitude of approximately 800 feet above ground level. At 225 feet above ground level, the aircraft again deviated from the glide slope and began a descent that continued until the landing gear struck the Nos. 18, 17, 16, and 15 bars of the approach light system. The aircraft remained airborne, however, and it was landed successfully on Runway 9 Right.

Contact with the light system structure ruptured the left main landing gear tires, and caused minor damage to the left wing flaps. The approach light system was rendered inoperative because of substantial damage to the four light bars.

The National Transportation Safety Board determines that the probable cause of this incident was an unexpected and undetected divergence of the aircraft from the glide-slope centerline induced by a malfunction of the automatic pilot. This divergence occurred at an altitude from which a safe recovery could have been made. However, both the pilot and the first officer were preoccupied at the time with establishing outside visual reference under visibility conditions which precluded adequate altitude assessment from external clues. Consequently, the pilot did not recognize the divergence from the glide-slope in time to avoid contact with the approach lights.

1. INVESTIGATION

1.1 History of Flight

Eastern Air Lines, Inc. (EAL), Flight 9701 of December 21, 1971, a Boeing 727-100, N8168G, was a scheduled cargo flight from Charlotte, North Carolina, to Atlanta, Georgia. The crew consisted of a captain, first officer, and a second officer. There were no other persons aboard.

The flight departed from Charlotte, North Carolina, at 0405 e.s.t.¹ and operated routinely

¹All times herein are eastern standard, based upon the 24-hour clock.

until after the aircraft arrived over the outer marker of the instrument landing system (ILS) serving Runway 9 Right at the William B. Hartsfield Atlanta International Airport.

The following is a chronology of the events prior to the incident.

At 0434:50, Flight 9701 established radio communications with Atlanta Approach Control and was advised, "Weather is indefinite ceiling one hundred (feet), sky obscured, visibility, uh, one eighth of a mile with fog, and uh, Atlanta altimeter three zero zero two. The RVR² both runways, well let's see, on the right runway sixteen hundred, and eighteen on nine left."

The flight replied "Okay, we are in business on the right one."

At 0443:30, the flight was informed that the RVR had reduced to 1,200 feet. One minute later, Flight 9701 was turned to a heading of 110°. 3-1/2 miles from the Runway 9 Right ILS outer marker, and cleared for the approach.³

At 0445:00, Flight 9701, using the identification "Eastern ninety seven oh one," reported over the outer marker and was cleared to land.

At 0447, the flight asked, "Have you cleared 9701 to land?" The Atlanta local controller confirmed the landing clearance, and again advised that the RVR was 1,200 feet.

At 0449, the flight reported that it was on the ground, and 4 minutes later advised that it was on the northwest taxiway, unable to proceed further because of a flat tire.

At 0454:25, Flight 9701 contacted Atlanta Ground Control, and advised, "I think we, uh, tipped the approach light out there on the, uh, autopilot, if so just a hair, and I think we just barely tipped the approach lights out there so, uh, that may be a problem for you."

Atlanta Ground Control advised that the approach lights had gone off. Flight 9701 then ad-

vised, "Well, we just barely touched them, I think, on the, uh, pretty close to the end of the runway there."

Subsequently, it was found that the Nos. 18, 17, 16, and 15 bars of the approach light system⁴ had received substantial damage.

The captain of Flight 9701 was at the controls during this flight. He said that the automatic pilot had been used en route, and remained on for the approach. It functioned normally at the beginning; however, when the landing flaps were extended from the 25° position to the 30° position, porpoising (excursions above and below the glide slope centerline) occurred.

According to the crew, these excursions did not cause an off-course indication of more than one dot on the glide slope raw data display. At about 800 feet above ground level (AGL) the porpoising stopped, and the aircraft became stabilized on the glide slope. Near the ILS middle marker, the first officer called out "200 feet," "approach lights," and "glide slope extension."⁵ The captain stated that he did not look up when the approach lights were called in sight. He continued to observe the instruments, and when the aircraft was at 150 feet, according to the radar altimeter, and slightly above the glide slope, an abrupt pitch-down occurred. He said that the pitch-down was recognized by the feel of the control column. He then disconnected the automatic pilot before he applied any pressure on the control column, and possibly added power

⁴The standard United States Approach Light System (ALS) consists of a number of light bars installed symmetrically about the extended runway centerline starting at the landing threshold and extending a distance of 3,000 feet outward into the approach zone. The longitudinal spacing of these light bars is 100 feet. The system provides roll guidance, a distinctive marker at 1,000 feet, and a distinctive threshold.

⁵Glide slope extension is initiated when the middle marker signal is received. A light on the panel signals that the automatic pilot is then functioning in the glide slope extension phase. In this phase the vertical speed command remains at the computer stored average rate of descent established between the ILS outer and middle markers. The glide slope deviation signal is reduced by a ratio of 4 to 1. The stored rate of descent plus the reduced programmed glidepath signal are the controlling factors during the glidepath extension phase.

²RVR - Runway Visual Range. A system of measuring the visibility along the runway. It is an instrumentally devised value that represents the horizontal distance a pilot will see down the runway from the approach end.

³The 1,200 feet RVR meant that the approach would have to be conducted pursuant to Category II Instrument Approach Procedures. See Appendix C for the Jeppesen Approach Chart for the approach.

to maintain airspeed. During this action, the aircraft struck the approach lights.

1.2 Injuries to Persons

There were no injuries.

1.3 Damage to Aircraft

The aircraft sustained minor damage, as follows:

- a. The Nos. 1 and 2 main landing gear wheels (left main landing gear) were deformed.
- b. The Nos. 1 and 2 main landing gear tires were torn and ruptured.
- c. The left main landing gear spoiler actuating linkage was broken.
- d. The left main landing gear anti-skid conduit was broken.
- e. The left main landing gear strut door upper hinge was deformed.
- f. The leading edge of the left main landing gear strut door was deformed. The door was distorted out of position.
- g. The outboard flap-track fairing for the left-hand inboard flap was damaged.

1.4 Other Damage

The Nos. 18, 17, 16, and 15 bars of the ALS received substantial damage to the stanchion platforms, the transformer enclosures, flasher lights (including box and electronic components), and the lamps and lamp holders. There were black scrub marks along the centerline of the platforms.

The approach-light structure was penetrated to a depth of 32 inches below the elevation of the highest structural point, which is 1029.11 feet mean sea level (m.s.l.).

1.5 Crew Information

The crewmembers were certificated and qualified for the operation involved. See Appendix B for detailed information.

At the time of the incident, they had been on duty for 10 hours 15 minutes.

1.6 Aircraft Information

The aircraft was a Boeing 727-25C, otherwise identified as a Model 727-100, as sold to Eastern Air Lines, Inc. This aircraft is certified for the "worst case" malfunction of the automatic flight control system. According to the Boeing Company, the "worst case" malfunction is a nosedown, hardover control input by the automatic flight control system, with a 1 second delay allowed before corrective action is taken. Under this circumstance, the demonstrated maximum deviation below the glide slope was 24 feet. Total altitude loss before the aircraft was returned to glide slope centerline was 70 feet. (See Appendix D.)

The aircraft gross weight at the time of the incident was approximately 142,000 pounds. The approach reference speed was computed to be 131 knots.

The aircraft was within weight and balance limits.

1.7 Meteorological Information

The Atlanta International Airport surface weather observations pertinent to this incident were, in part:

0409 - Special observation - Indefinite ceiling 100 feet, sky obscured, visibility 1/8 mile, fog, wind 240° at 3 knots, altimeter setting 30.02 inches of mercury, Runway 9 Right visual range 1,400 feet variable to 1,600 feet.

0453 - Record special observation - Indefinite ceiling zero, visibility 1/8 mile, fog, temperature 56°, dew point 56°, wind 270° at 3 knots,

Runway 9 Right visual range 1,000 feet variable to 1,200 feet.

1.8 Aids to Navigation

Runway 9 Right at the Atlanta International Airport is served by an ILS, operating within Category II instrument approach tolerances. This system has an outer marker, middle marker, and an inner marker. The approach light system is the standard United States Configuration A. (See Appendix C for additional Aids to Navigation information.)

Following this incident, the ILS was flight checked by the Federal Aviation Administration (FAA) and was found to be operating within prescribed tolerances.

Two other EAL aircraft, Flights 9091 and 452, had landed on Runway 9 Right at 0434:50 and 0445:40, respectively. Neither crew reported any difficulty or abnormal operation of the ILS.

1.9 Communications

There were no communication difficulties between EAL Flight 9701 and the various FAA facilities.

1.10 Aerodrome and Ground Facilities

Runway 9 Right is 150 feet wide and 8,000 feet long. It is grooved and equipped with touchdown zone and runway centerline lights. The touchdown zone elevation is 1,015 feet m.s.l. A visibility transmissometer is located near the approach end of the runway.

All facilities were operating normally prior to the incident.

1.11 Flight Recorders

N8168G was equipped with a UCDD (Sundstrand) Model FA-542 flight data recorder (FDR) and a Fairchild Model A-100 cockpit voice recorder (CVR).

Information from the CVR is obtainable for only the last 30 minutes of recorder operation. Because the recorder remained in operation after the landing, while the aircraft was awaiting assistance to move from the taxiway, the conversation during the approach was erased by subsequent recordings. However, the crew discussed the approach during this waiting period, and a transcript has been made of their recorded comments. These conversations disclosed that:

1. A coupled approach, using the automatic pilot in accordance with company procedures, was being conducted.
2. "Porpoising" occurred to an unusual degree during the initiation of the approach.
3. The porpoising had stopped at about 600 feet AGL, leading the captain to conclude that there would be no further difficulty.
4. A pitch downward occurred at 200 feet, according to the first officer.
5. The captain believed the pitchover occurred at 150 feet.
6. The first officer commented, "...it looked to me like this... pitched over, and suddenly disconnected, and started flattening out..." The captain replied, "It did, that's why I disconnected when I saw the lights come up, sec. I didn't pull it up quick enough."

The flight data recorder readout disclosed that the initial intercept and glide-slope capture were normal. The altitude trace showed a divergence from a straight-line descent approximately 20 seconds after the start, with rates of descent varying from 300 feet per minute (f.p.m.) to 1,900 f.p.m. before becoming stabilized 40 seconds after the onset of the excursions.

Airspeed during this interval varied from 143 knots to 157 knots. Nine seconds before contact with the approach lights, with the aircraft at ap-

proximately 225 feet AGL, the rate of descent started to increase, reaching about 1,800 f.p.m. shortly before contact with the approach lights. Airspeed during this interval started at 143 knots and reached 153 knots at impact.

1.12 Aircraft Wreckage

Not applicable

1.13 Fire

There was no fire.

1.14 Survival Aspects

The incident was survivable.

1.15 Tests and Research

a. Test Approaches Using the Automatic Flight System

Subsequent to the incident, the aircraft was ferried to Miami, Florida, for examination. During this flight, three automatic-flight-system approaches were made. The first was to Runway 9 Right at Atlanta, the second to Dade-Collier Airport at Miami, and the third to Miami International Airport.

The FDR readout for these approaches showed that:

1. The approach at Atlanta had an initial divergence above and below the glide slope centerline, similar to the approach resulting in the incident, but of less magnitude.
2. The altitude trace of the approach to Miami Dade-Collier Airport diverged only slightly above and below the glide slope centerline, but less than during the ferry flight approach to Atlanta.
3. The altitude trace of the approach to Miami International Airport diverged only slightly above the glide slope upon initiation of the approach.

All of these approaches were considered to be within the normal operating characteristics of the aircraft's automatic flight system.

b. Examination of the Aircraft's Automatic Approach System

Upon arrival of the aircraft at Miami, Florida, the following avionics components were removed and bench checked.

1. The No. 1 very high frequency navigation receiver.
2. The radar altimeter transmitter/receiver unit.
3. The automatic pilot pitch command control channel.

The bench checks revealed that the rate gyroscope in the pitch command channel had dry and worn bearings, and that there was no electrical output.

No other discrepancies were discovered.

Concerning the rate gyroscope, The Boeing Company advised that "a failed rate gyro affects only the short period attitude damping of the airplane, and will tend to produce oscillations with a three-to-five second period about the glidepath, with minor flightpath deviations."

The Board sent to the Boeing Company a copy of the FDR readout, and requested their opinion as to whether the failure of the rate gyroscope could produce the flightpath shown. The company's reply, in part, stated, "There is no autopilot malfunction, of which we know, that can cause the type of maneuvering shown on the subject incident readout. Our flight testing of various faults including hardovers, slowovers, and failed rate gyros during certification testing showed no conditions which resemble this incident."

With respect to the FDR altitude trace for the last 6 to 7 seconds prior to impact, the Boeing Company analysis stated, "... it would appear that the autopilot was not engaged and thrust

was reduced to idle. This is the only way that the descent profile . . . could be developed with the speed increasing as little as it did.⁶

c. In flight Observations and Simulator Flight Tests

During this investigation, a Safety Board investigator observed four ILS approaches⁶ with a Category II certificated automatic flight system in use. Two of the approaches were discontinued because the automatic pilot did not hold the localizer course properly. The other two were completed to Category II minimums without incident. In no instance did the aircraft deviate noticeably from the glide slope when the flaps were extended from the 25° to the 30° position, nor was there any porpoising during the approach.

Flight tests were conducted in an Eastern Air Lines, Inc., Boeing 727 flight simulator to determine if the excursions shown on the FDR read-out could be duplicated, or approximated, by entry on the approach with excess speed, or by control inputs by the pilot to override the automatic pilot. These tests were not conclusive and demonstrated only that the flightpath of the incident situation could not be approximated with a properly functioning automatic pilot.

1.16. Other Information

a. Information provided by the Boeing Company

1. During certification testing, hardover autopilot malfunctions were initiated at 254 feet AGL by inducing a saturating electrical signal directly into the valve amplifier, of such a magnitude that feedback could not cancel it out.

⁶ All approaches were made in the regular course of scheduled operations, but were conducted in visual meteorological conditions.

2. The test pilot responded to the hardover signal in 1.7 seconds after initiation at 254 feet AGL, and disconnected the autopilot.

3. There was a 24-foot altitude deviation below the glide slope during recovery. The total change in altitude from initiation of the hardover signal to recovery of the glide-path was 70 feet.

4. The pilot recognized the deviation by the movement of the control column.

5. At the time of recognition, there was one-tenth of a dot glide-slope indicator deviation and 2° of nosedown pitch attitude change.

6. A pitch attitude of 3.5° above the previously stabilized attitude of 3° noseup was used in the recovery.

7. The pitch attitude (deck angle) required to maintain the 7: -100 aircraft on a 2.6° glide slope, at 143,000 pounds gross weight and 143 knots indicated airspeed, with a flap setting of 30° is + 1.1°.

8. The depressed viewing angle⁷ over the nose of the Boeing 727-100 from the reference eye position is 14° relative to body waterlines.

b. EAL B-727 Airplane Flight Manual and Flight Operations Manual Information

1. The operating Procedures section of the Airplane Flight Manual states that altitude loss due to a hard-down automatic pilot simulated malfunction during an ILS approach results in an altitude loss of 28 feet. The Expanded Check List section notes,

⁷ Depressed viewing angle - the angle between the longitudinal axis of the aircraft and the sight line of the pilot through the forward windscreen, below which objects are obscured by the aircraft structure.

"In case a go-around becomes necessary, it should be kept in mind that with the engines at idle, 6 to 12 seconds will be required to accelerate to takeoff RPM and thrust. With the engines spooled up approximately 70 percent, not more than 4 seconds will be required to accelerate to takeoff RPM and thrust. In the event the rate of descent should increase above the maximum usable, an immediate power increase will correct the situation."

2. The company Flight Operations Manual notes that a missed approach should be initiated when any of the airborne equipment required for a Category II approach becomes inoperative, except that an approach may be continued using the flight director system if the automatic approach coupler malfunctions and is disengaged below 400 feet above the elevation of the touchdown zone.
3. The EAL B-727 Flight Manual, with respect to Category II approaches, states, "From 300 feet to the DH (decision height) raw ILS deviation should not exceed ± 1 dot on glide slope, or $\pm 1/3$ dot on localizer".

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The recorded crew conversations on the ground immediately following the incident leave no doubt that the approach was being made by use of the automatic pilot and approach coupler. Equally certain is the fact that the automatic pilot did not capture the glide slope in a normal manner. The porpoising discussed by the crew is confirmed by the FDR readout. The pitch-down occurred prior to the automatic pilot disconnect, and the rapid deviation from the glide slope occurred as a result of the pitch-down maneuver. However, the subsequent exam-

ination of the aircraft's automatic flight system disclosed no reason for the deviation. The only discrepancy found was the failed rate gyroscope in the pitch control channel. This gyroscope affects short-period damping only, and failure of it would not have produced the 18-second oscillation interval shown on the FDR.

The oscillations were not the result of malfunctioning of the groundbased equipment, as evidenced by the flight check of the facility by the FAA and the successful approaches of the other two EAL flights immediately ahead of Flight 9701.

It is noted that the three ILS test approaches made by N8168G following the incident showed successively better performance of the automatic flight system. Some of this improvement might have been due to the slower entry airspeeds involved, lighter aircraft weight, differences in center of gravity, or wind conditions during the approach. It also, however, might be indicative of an automatic flight system condition that was self-correcting as the equipment remained in operation.

Whereas the reason for the failure of the automatic flight system to capture the glide-slope in a satisfactory manner during the initial entry into the procedure and to keep the aircraft on the glide-slope thereafter has not been determined, the Safety Board believes that this failure in itself should not have caused the aircraft to come into contact with the approach lights. The Board believes that the captain's estimate of the altitude at which the deviation from the glide-slope occurred is lower than the actual altitude, and that if the automatic pilot malfunction had been detected and the deviation recognized in the first few seconds after it occurred, a correction could have been made in ample time to avoid collision with the approach light structure. The reasons for this belief are as follows:

- a. If the aircraft had, in fact, been at, or very slightly above, the glide-slope at 150 feet AGL when the pitch-down occurred, the aircraft would have been positioned 3,310 feet from the glide-slope intersect point

with the runway. This point is 1,250 feet from the threshold. Since the approach light bars are spaced 100 feet apart, the aircraft then would have been positioned approximately over the No. 21 light bar. The ground speed of 145 knots is equal to 245 feet per second (f.p.s.). Accordingly, the aircraft would have had to descend 136 feet, to the top of the No. 18 light bar, while moving forward 300 feet. The total slant distance traveled would have been 330 feet. This would require the initiation of a rate of descent in excess of 6,000 f.p.m., a descent profile 25° downward, and arrest of the descent rate, all in 1.3 seconds.

Performance in this manner is beyond the capability of the aircraft.

- b. The second officer's statement indicates that the pitchover occurred at about 200 feet AGL, shortly after the approach lights were called in sight. His remembrance is supported by the FDR readout, which shows that a rapid deviation below the glide slope began at an altitude of approximately 225 feet, 9 seconds before contact with the approach lights.
- c. Six seconds before contact, the aircraft was at 175 feet AGL, well below the glide slope. The glide-slope raw-data display would have shown more than a two-dot deflection--a warning of the unacceptably low position of the aircraft below the glide slope. At that time, a correcting maneuver could have been accomplished without difficulty, if the captain had been observing the instruments. As previously noted, the EAL B-727 Flight Manual states, "From 300 feet to the DH (decision height) raw ILS deviation should not exceed ± 1 dot on glide slope . . ." A deviation of more than one dot on the glide-slope display, with the aircraft in the vicinity of the middle marker, should have resulted in immediate corrective action. The flight director system would have shown a "fly-up" command.

In consequence of the foregoing discussion, the Safety Board believes that upon the calls of "200 feet" and "approach lights," the captain looked up from the instruments and thereafter conducted the approach by reference to the approach lights. This would not be an unusual circumstance with the approach lights called in sight, and in fact would have been the accepted procedure if the approach were being conducted to Category I minimums.⁸

As a result of the captain's looking up, and the first officer's already looking outside, neither pilot was in a position to observe the deviation on the glide-slope raw-data indicator, or the flight director system, either of which would have alerted them to an abnormal situation.

It is considered likely that the control column movement, which might have alerted the captain to a change in pitch attitude, was masked by the poor performance of the automatic flight system up to that point.

With a depressed viewing angle of 14°, an aircraft attitude of 1.1° noseup, and assuming a slant visibility in the approach zone equal to the FVR of 1,200 feet recorded on the runway, the pilot would have had a ground visual guidance segment of less than 300 feet, from an altitude of 200 feet AGL. Accordingly, only two of the light bars would be visible initially. The approach lights would have had a "halo" effect surrounding them because of light backscatter from the water droplets in the fog. Thus, while lateral and roll guidance would have been available from the approach lights, the pilot would have had little, or no, altitude information from them. It is noted that the description of the United States standard ALS⁹ does not make any claim for use of the lights to determine height or pitch attitude. In fact, studies¹⁰ relating to the need for a visual approach-slope indicator for jet aircraft have noted that reliable altitude or aircraft attitude information is not

⁸Category I decision height is 200 feet AGL.

⁹Approach Light System.

¹⁰E.S. Calvert - "Safety and Regularity in Landing." Journal of the Royal Aeronautical Society, 1959.

available from approach lights until the aircraft is 100 feet or less above them.

As an aircraft descends, the visual guidance segment available to the pilot increases. In this instance, at an altitude of 100 feet, assuming the slant visual range in the approach zone was equal to the 1,200 RVR recorded on the runway, the ground segment visible to the pilot would have increased to about 800 feet, and would have included nine of the approach light bars. Thus, as the aircraft descended, the "stacking" effect of the bars, and the sharpening outline of the individual lights would have provided an indication of the unacceptable altitude and pitch attitude of the aircraft, and the need for corrective action would have become apparent.

The Safety Board believes that the reduction of the engine power to flight idle, as discussed in the Boeing Company analysis of the FDR data, also indicates that the captain was not aware of the deviation from the glide slope, in the initial moments of descent, and as a result did not take corrective action in time to avoid collision with the approach lights.

2.2 Conclusions

a. Findings

1. The crewmembers were certificated and qualified to conduct instrument approaches to Category II minimums.
2. The approach was made with the automatic flight system engaged.
3. The automatic flight system did not function as well as would be expected during any part of the approach, even with the pitch command control rate gyroscope inoperative.
4. The aircraft departed from the glide slope just before it passed over the ILS outer marker.

5. The altitude of the aircraft at the time of the pitch-down was approximately 200 feet or 50 feet higher than the captain's estimate.
6. The deviation from the glide-slope was not immediately recognized by the crewmembers, since both the captain and first officer were looking at the approach lights when the deviation occurred.
7. The approach light system does not provide adequate altitude or aircraft pitch attitude information during low-visibility approaches.

b. Probable Cause

The National Transportation Safety Board determines that the probable cause of this incident was an unexpected and undetected divergence of the aircraft from the glide-slope centerline induced by a malfunction of the automatic pilot. This divergence occurred at an altitude from which a safe recovery could have been made. However, both the pilot and the first officer were preoccupied at the time with establishing outside visual reference under visibility conditions which precluded adequate altitude assessment from external clues. Consequently, the pilot did not recognize the divergence from the glide-slope in time to avoid contact with the approach lights.

3. RECOMMENDATION

The National Transportation Safety Board recognizes that at present there is no requirement for a pilot to continue to monitor the instruments down to decision heights after the approach lights or other ground environment associated with the end of the runway is called in sight. In fact, in a "see to land" concept it is understandable that a pilot would wish to make

a transition from instrument guidance to ground visual guidance as early as possible. However, in circumstances of low visibility, particularly as related to Category II minima, the approach lights may often be in sight before the decision height is reached, but they will not provide a visual guidance segment sufficient to furnish adequate vertical information to the pilot. The result can be a touchdown far short of the threshold, as in this instance.

Accordingly, the Safety Board recommends that:

The Federal Aviation Administration require that air carriers establish procedures in their operations manual that would require the pilot who flies an aircraft during approaches in low visibility conditions to monitor the instruments continuously until the runway threshold, or runway lights are called in sight.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

/s/ JOHN H. REED

Chairman

/s/ FRANCIS H. McADAMS

Member

/s/ LOUIS M. THAYER

Member

/s/ ISABEL A. BURGESS

Member

/s/ WILLIAM R. HALEY

Member

July 26, 1972.

INVESTIGATION AND HEARING

1. Investigation

This incident was investigated by the Safety Board's Field Office at Miami International Airport, Miami, Florida. Interested parties participating in the investigation included the Federal Aviation Administration, Eastern Air Lines, Inc., and the Air Line Pilots Association.

2. Hearing

There was no public hearing.

3. Preliminary Reports

A preliminary report was not issued.

CREW INFORMATION

Captain Joe K. Gemmill, aged 52, held Airline Transport Pilot Certificate (No. 391001) and was type rated in the Boeing 727. At the time of the incident, he had accumulated a total of 17,300 hours of which 2,000 hours were in the Boeing 727 type aircraft. He held a First-Class Medical Certificate dated June 17, 1971, with no limitations. His last proficiency check was accomplished in a satisfactory manner in July 1971. This check included recurrency qualifications for Category II operations as pilot-in-command. Company records reflect that Captain Gemmill was one of the active pilots involved in accumulating the requisite Category II demonstration flights for Eastern Air Lines Category II certification. He was based at Atlanta, Georgia, and was familiar and current in the particular approach involved.

First Officer John G. Threlkeld, aged 31, held Airline Transport Certificate (No. 1515749) and was type rated in the Boeing 727. At the time of the incident, he had accumulated a total of 5,300 hours of which 3,900 hours were in the Boeing 727 type aircraft. At the time of the incident, he had been on duty continuously for 10 hours and 15 minutes. He held a current First-Class Medical Certificate with no limitations. His last proficiency check was accomplished in a satisfactory manner in August 1971.

Second Officer W.I. Jackson, Jr., aged 32, held a Flight Engineer Certificate (No. 1771749) with ratings for turboprop and turbjet aircraft. He held a current First-Class Medical Certificate.

AUTOPILOT (Single or Dual Channel Operation)

The autopilot controls the airplane in the aileron and elevator axis. Yaw damper is a separate function.

Demonstrated altitude loss due to a hard-over simulated autopilot malfunction is:

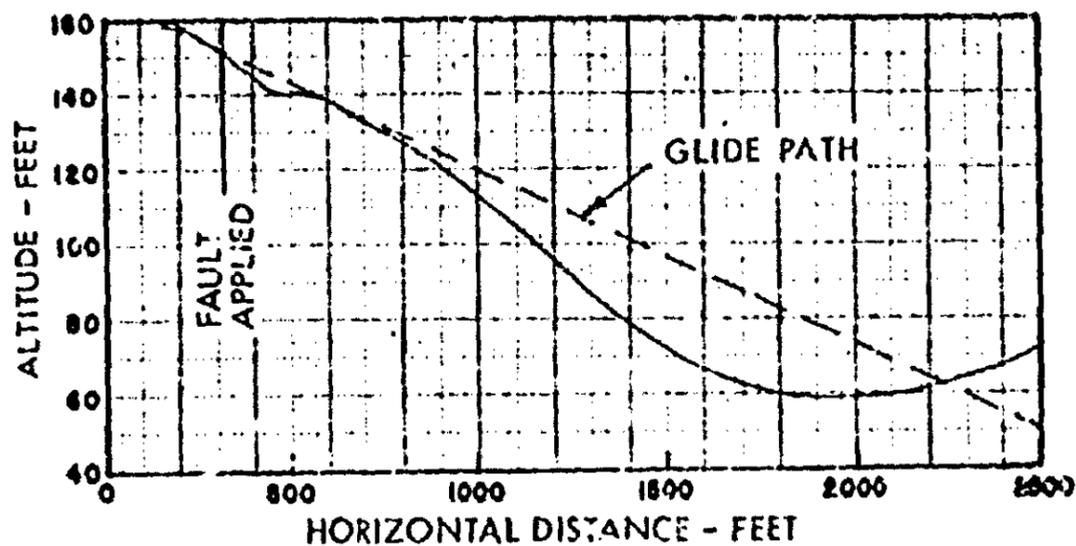
LEVEL FLIGHT 380 feet when recovery was initiated in three seconds.

ILS APPROACH

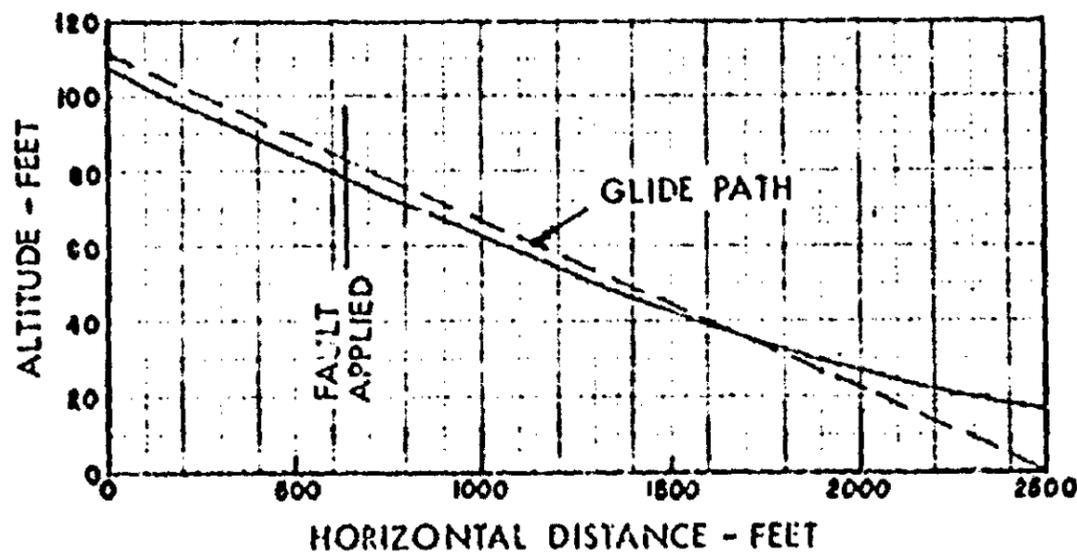
Automatic Approach and Landing Negligible loss for Dual Channel (AB) operation.

Automatic Approach (Single Channel A or B operation to Category II):

- (a) Altitude loss above 100 feet 24 feet below glide slope when recovery was initiated one second after pilot recognition. (See profile chart.)



- (b) Altitude loss below 100 feet Negligible when recovery was initiated without delay after pilot recognition. (See profile chart.)



Aug/14/70

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