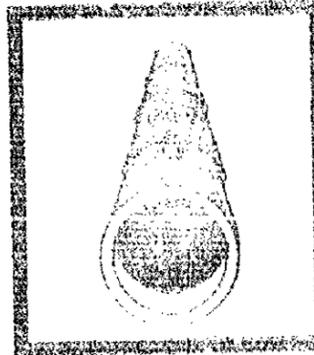
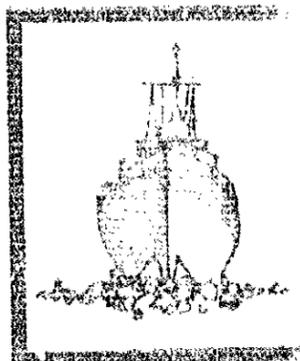
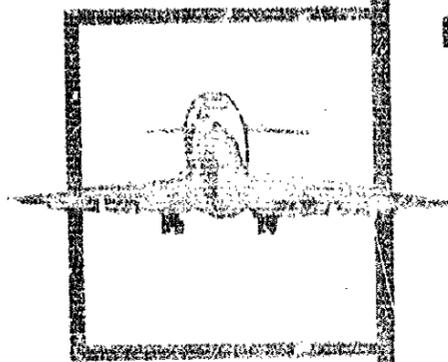


PB87-910413



NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY REPORT

NEWARK, NEW JERSEY - - NOVEMBER 13, 1986

NTSB/AAR-87/04/SUM

UNITED STATES GOVERNMENT

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**National
Transportation
Safety Board**

Washington, D.C. 20594

AIRCRAFT ACCIDENT/INCIDENT SUMMARY

File No.:	87-2331
Aircraft Operator:	Delta Air Lines
Aircraft Type and Registration:	Lockheed L-1011-385-1, N714DA
Location:	Newark International Airport Newark, New Jersey
Date and Time:	November 13, 1986, 1223 eastern standard time <u>1/</u>
Occupants on Board:	137
Injuries:	None
Aircraft Damage:	Substantial
Type of Occurrence:	Airframe/Component/System Failure/Malfunction
Phase of Operation:	Flare/Touchdown

Delta Air Lines flight 1984 (DL 194), a Lockheed L-1011-385-1 airplane, N714DA, departed Dallas/Fort Worth International Airport on November 13, 1986, for Newark, New Jersey, with an en route stop at Atlanta, Georgia. DL 194 departed Atlanta at 1030 with 137 persons on board. The flight from Atlanta to Newark was reported by the flightcrew to be without incident.

About 1215, DL 194 was cleared to intercept the localizer at Newark for an approach to runway 4 right (4R), to proceed to the outer marker, and then to circle to land on runway 29. At 1219:36, the flightcrew of DL 194 contacted the local controller (LC) at the Newark Tower, who gave the following clearance, "Delta One Ninety Four Heavy, Newark Tower circle east, for runway two niner at the marker Uh straight to land four right."

DL 194 did not accept runway 4R. Instead, the captain accepted the circling approach to land on runway 29. At 1223:03, the LC informed the flightcrew, "Delta One Ninety Four heavy clear to land runway two niner wind three forty at one eight." The DL 194 flightcrew acknowledged the transmission from the LC.

After DL 194 landed, it was cleared for a left turn at Taxiway "Uniform," at which time the LC advised the flightcrew, "It appears that your right main is smoking a little bit." The flightcrew acknowledged, and then contacted the Newark Ground Controller (GC), who stated,

Delta One Ninety Four Heavy Newark ground hold turn left there and just hold your position there after you make the left turn, there appears to be a large amount of water and/or steam or smoke or something looks like hydraulics coming out of the left main.

1/ All times have been converted from Universal Coordinated Time (UCT) to eastern standard time by subtracting 5 hours. Times are shown using a 24-hour clock.

At 1227:32, the flightcrew of DL 194 shut down the engines. The LC called airport crash/fire/rescue teams, who arrived at the airplane within 2 minutes. There was no fire or emergency evacuation, and all occupants deplaned through the main cabin door using portable stairs. There were 137 persons on the airplane: 114 revenue passengers, 13 nonrevenue passengers, 3 flightcrew members, and 8 flight attendants. There were no reported injuries.

The airplane sustained substantial damage, which was confined to the right wing and included upper and lower skin panel deformation and the separation of the rear wing spar. The rear spar was separated outboard and diagonally downward, between inboard wing station 241.0 (IWS 241.0) and IWS 293.5 (See figure 1.)

The National Transportation Safety Board, Delta, and Lockheed personnel examined the fractured surface of the spar and found an approximately 6 3/4-inch-long aggregate fatigue crack in the spar web that separated from a "HI-LOK" fastener hole used to attach a doubler to the side of the spar web. (See figures 2 and 3.) On the inboard side of the doubler, two vertical Z-shaped stiffeners were attached to the aft side of the web to provide reinforcement around the fuel fill valve hole in the spar. Another doubler was attached to the back side of the web between the stiffeners. The fatigue crack was on the forward surface of the spar web adjacent to, and on each side of, the lower inboard 5/16-inch "HI-LOK" fastener hole that attaches the forward (inner) doubler. The fatigue began in an area that was not visible from the forward side of the spar because it was masked by the doubler.

The fatigue cracks initially propagated aft through the web thickness and away from the fastener hole. The fatigue cracks propagated approximately 4 1/4 inches inboard and up, and about 2 3/8 inches outboard and down from the fastener hole. (See figures 4 and 5.) The fatigue crack in the latter stages appeared to be growing rapidly, which is typical of a crack reaching critical crack length. As a result, the total fracture of the rear spar could have resulted from the fatigue region under normal loading conditions. The weakening of the wing structure by the complete fracture of the rear spar was considered critical to the operation of the airplane within the design flight envelope.

The other damage to the upper wing skin panels at the wing root is shown in figure 3. The wing spar forms the aft section of the wing integral fuel tank; therefore, when the spar separated, fuel leaked from the tank.

The flightcrew was qualified for the flight. The captain held airline transport certificate No. 1133120 with ratings for L-1011, B-727, and DC-3 airplanes. He had a total of 19,000 flying hours, 2,400 of which were flown in the L-1011. His last 6-month proficiency check was accomplished July 10, 1986, and his last first-class medical certificate was issued September 26, 1986, with no limitations.

The first officer held a commercial pilot's certificate for airplane-single/multi-engine land and instrument. He had a total of 12,000 flying hours, 4,500 of which were flown in the L-1011. His last annual proficiency check was accomplished on March 3, 1986, and his last first-class medical certificate was issued April 15, 1986, with no limitations.

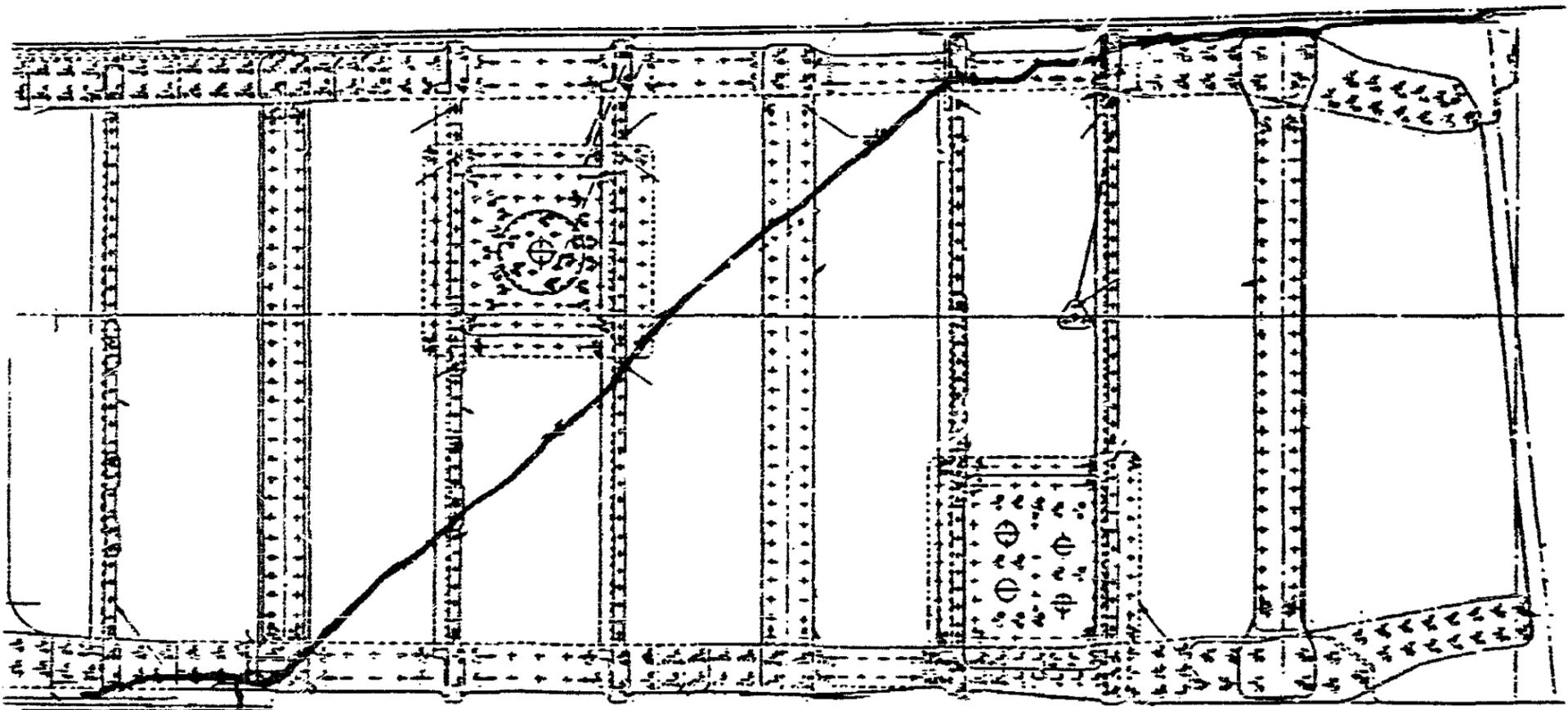


Figure 1.--Inboard rear spar fracture line.

Inboard Rear Spar Fracture Line-Looking Aft (Left Spar Shown)



Figure 2.--Damage to the wing and rear spar of the right wing, looking up and forward at spar web crack.

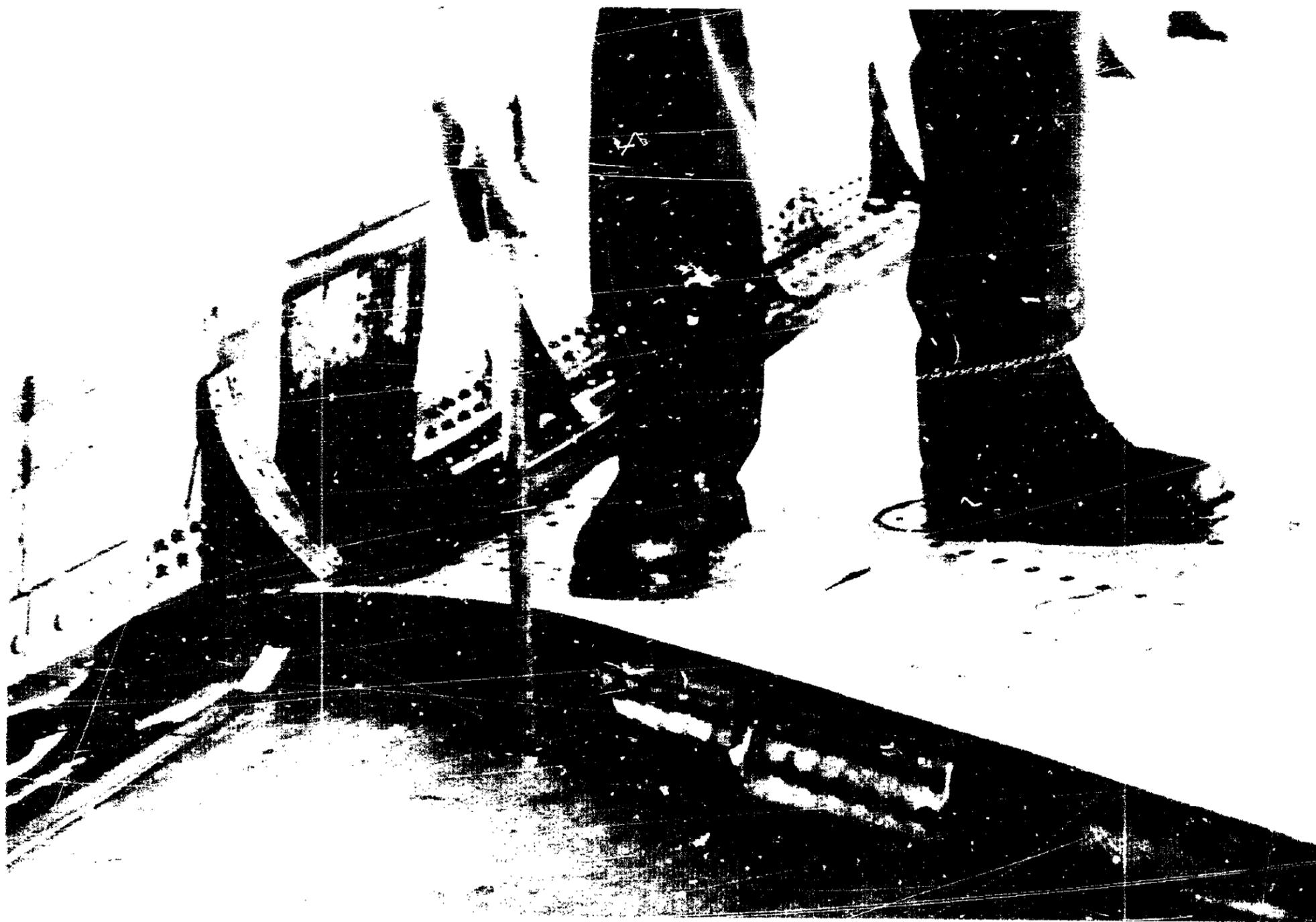


Figure 3.—Distortion of rear spar and upper skin of the right wing.

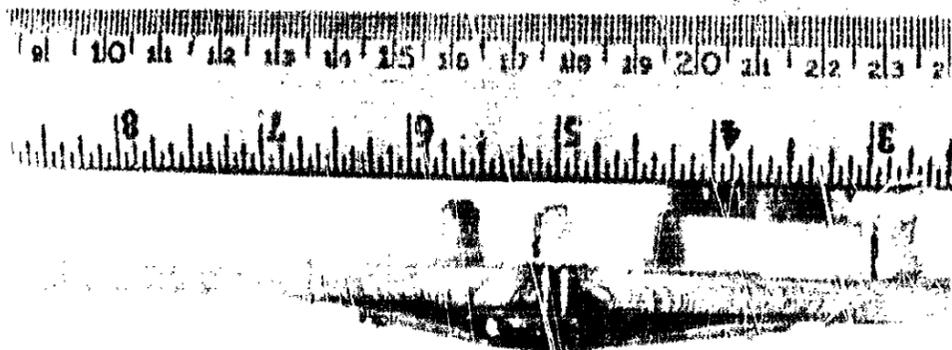


Figure 4.--Fatigue crack in rear spar web of the right wing.

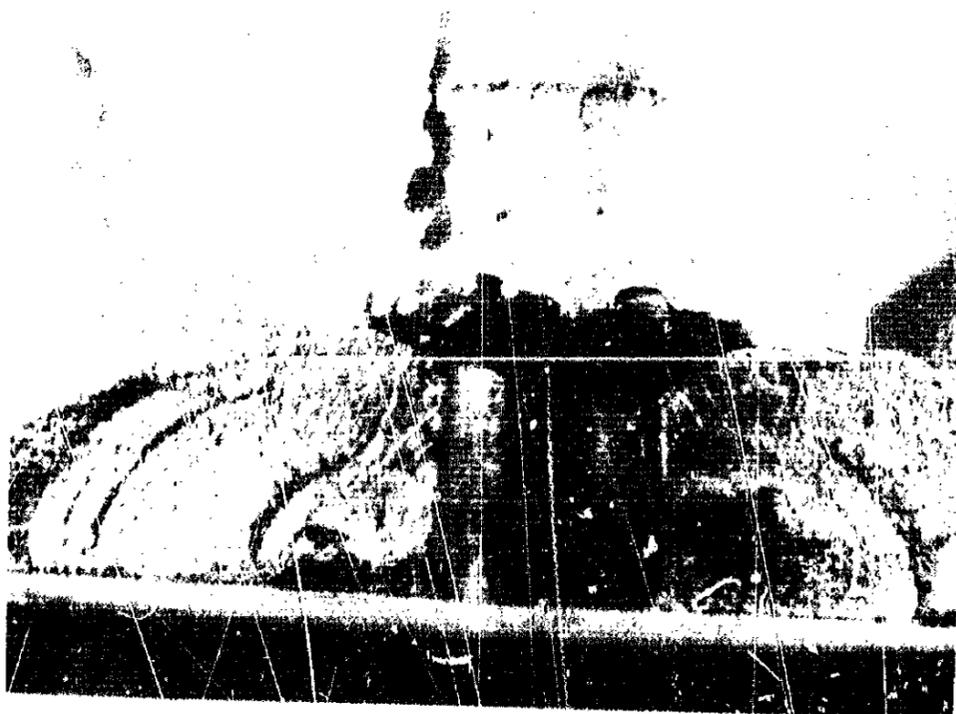
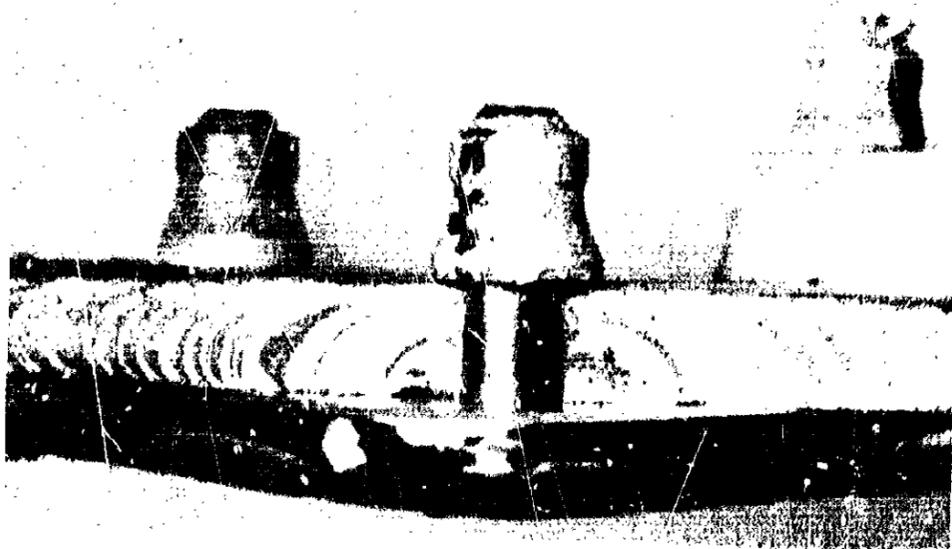


Figure 5.--Fatigue crack in rear spar web of the right wing.

The second officer held a flight engineer's certificate No. 1882366 with a turbojet-powered rating. He had a total of 11,000 flying hours, 5,200 of which were flown in the L-1011. His last annual proficiency check was accomplished on March 9, 1986, and his first-class medical certificate was issued September 22, 1985, with no limitations.

The airplane, a Lockheed L-1011-385-1, was operated and maintained by Delta in accordance with the Federal regulations that apply to domestic air carriers. On the day of the accident, the airplane's total time was 37,445.5 hours and 21,788 cycles. 2/

The right wing spar in the area of the failure had been visually inspected internally and externally at the last letter check (P-2) on July 23, 1986, at 36,540.9 hours and at 21,308 cycles. The airplane records show that no unscheduled maintenance inspections had occurred as a result of reported hard or overweight landings, abnormal airplane vibrations, or an encounter with severe in-flight turbulence.

The 1150 recorded surface weather observation for Newark was:

3,500 feet scattered,
15 miles visibility,
temperature 40° F,
dewpoint 12° F,
wind from 320° at 19 knots, and
altimeter 30.26 inches (Hg).

No wind gusts were reported on this observation.

The 1250 surface weather observation recorded after the accident was:

3,500 feet scattered,
15 miles visibility,
temperature 39° F,
dewpoint 4° F,
wind from 320° at 20 knots gusting
to 27 knots,
altimeter 30.26 inches (Hg), and
remarks, winds variable 270° to 360°.

The National Weather Service (NWS) wind gust recorded for Newark Airport for 1200 to 1220 recorded a maximum wind speed of 20 knots (at 1200) and minimum wind speed of 13 knots (1211).

The NWS issued an advisory on the evening of November 12 for high winds, covering local airports in New Jersey, including Newark. The advisory stated that after the passage of a front, the winds behind the front (postfrontal passage) would possibly be 35 to 40 knots with gusts all day Thursday (the day of the accident), and with low-level windshear expected for 2 to 3 hours in the wake of (behind) the frontal passage.

The terminal (Newark) forecast issued from NWS in New York from 1000 to 1500 was:

Ceiling 400 feet broken, wind from 320° at 20 knots, gusting to 32 knots.
Remarks: clouds broken, occasionally scattered.

2/ A cycle is defined as a takeoff and landing.

Newark Airport has an operational low level windshear alert system (LLWAS) installed with a monitor (SENSOR) located at the approach end of runway 29. The LLWAS was operational during the entire time that DL 194 was under control of the Newark Air Traffic Control System.

The captain of New York Air flight 308, which landed just ahead of DL 194, stated that there was moderate turbulence during the approach with airspeed fluctuations of plus or minus 15 knots. He further stated that the winds were blowing very hard and he did not remember receiving any LLWAS alarm from the tower at any time while on the approach. He also stated, given the weather conditions, there must have been some windshear.

The navigational aids that service Newark Airport were operational.

The Digital Flight Data Recorder (DFDR) was removed from the airplane and sent to the Safety Board's laboratory in Washington, D.C., for readout and evaluation. The recovered data indicated that the recorder operated normally except for a number of brief, out-of-synchronization periods and several areas where the chronological order of the data was lost.

The last 25 hours of recorded data were examined and the plus and minus normal or vertical acceleration forces noted. The highest plus (positive) acceleration was about 1.4 Gs (recorded during the landing at Newark) and the lowest was 1.1200 Gs; the highest minus (negative) acceleration force was .9735 Gs, and the lowest was .7320 Gs. The 1.4 plus G force recorded at Newark is well within the certification parameters of the airplane for landing loads.

No information was recovered from the cockpit voice recorder because the flightcrew restarted the auxiliary power unit and operated it continuously for more than 30 minutes.

As a result of the findings, on November 19, 1986, the Safety Board made the following recommendations to the Federal Aviation Administration (FAA):

Require an immediate inspection using methods adequate to detect fatigue cracking of the wing rear spar with emphasis on the spar web at the lower inboard fastener hole for the forward side doubler reinforcing the fuel filler valve hole of all Lockheed L-1011 airplanes having more than a conservatively established threshold of both flight hours and flight cycles; the threshold should be predicated upon the time and cycles on the accident airplane. (Class I, Urgent Action) (A-86-128)

Revise the approved inspection programs for Lockheed L-1011 airplanes as necessary to establish inspection thresholds, intervals, and methods which are adequate to detect fatigue cracking of primary wing structure. (Class II, Priority Action) (A-86-129)

Notify foreign certification authorities about the circumstances of this accident and the need for remedial actions. (Class I, Urgent Action) (A-86-130)

With regard to Safety Recommendations A-86-128 and -129, on November 20, 1986, and on December 18, 1986, the FAA issued Telegraphic Airworthiness Directive (AD) T-86-23-52 and AD T-86-23-52-R1, which required initial and repetitive visual and ultrasonic inspections, respectively, of the rear wing spar on the Lockheed L-1011

airplanes, and inspection thresholds intervals and methods to detect wing spar cracks. Upon review, the Safety Board found that these ADs complied with the intent of its recommendations. Therefore, Safety Recommendations A-86-128 and -129 have been classified as "Closed--Acceptable Action."

The fact that ADs were required to institute inspection procedures to detect cracks in other airplanes, and the fact that the fatigue crack was able to propagate to failure without being detected by an approved inspection procedure, led the Safety Board to conclude that this deficiency was not adequately considered during the airplane's design.

With regard to Safety Recommendation A-86-130, the Safety Board found that all foreign governments known to operate the Lockheed L-1011 airplanes received the applicable ADs through the FAA's normal AD distribution system. Safety Recommendation A-86-130 therefore has also been classified as "Closed--Acceptable Action."

The attached aviation accident brief contains the Safety Board's findings and probable cause of the 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

/s/ JAMES L. KOLSTAD
Member

November 12, 1987

National Transportation Safety Board
Washington, D.C. 20594

Brief of Accident

File No. - 2331 11/13/86 NEWARK, NJ A/C Reg. No. N714DA Time (Lci) - 1225 EST

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

Type Operating Certificate	-AIR CARRIER - FLAG/DOMESTIC	Aircraft Damage	Injuries			
Name of Carrier	-DELTA AIRLINES	SUBSTANTIAL	Fatal	Serious	Minor	None
Type of Operation	-SCHEDULED, DOMESTIC, PASSENGER	File	Crew	0	0	23
Flight Conducted Under	-14 CFR 121	NONE	Pass	0	0	114
Accident Occurred During	-LANDING					

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

Make/Model	- LOCKHEED L1011	Eng Make/Model	- ROLL ROYCE RB-211-22B	ELT Installed/Activated	- YES-UNK/NR
Landing Gear	- TRICYCLE-RETRACTABLE	Number Engines	- 3	Stall Warning System	- YES
Max Gross Wt	- 430000	Engine Type	- TURBOFAN		
No. of Seats	- 302	Rated Power	- 42000 LBS THRUST		

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

Weather Data		Itinerary		Airport Proximity	
Wx Briefing	- COMPANY	Last Departure Point		ON AIRPORT	
Method	- IN PERSON	ATLANTA, GA			
Completeness	- FULL	Destination		Airport Data	
Basic Weather	- VMC	NEWARK, NJ		NEWARK INTERNATIONAL	
Wind Dir/Speed	- 320/019 KTS	ATC/Airspace		Runway Ident - 29	
Visibility	- 15.0 SM	Type of Flight Plan - IFR		Runway Lth/Wid - 6502/ 150	
Lowest Sky/Clouds	- UNK/NR	Type of Clearance - IFR		Runway Surface - ASPHALT	
Lowest Ceiling	- NONE	Type Appch/Lnds - ILS-LOCALIZER		Runway Status - DRY	
Obstructions to Vision	- NONE	FULL STOP			
Precipitation	- NONE				
Condition of Light	- DAYLIGHT				

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

Pilot-in-Command	Age - 59	Medical Certificate	- VALID MEDICAL-NO WAIVERS/LIMIT
Certificate(s)/Rating(s)	Biennial Flight Review	Flight Time (Hours)	
ATP	Current - UNK/NR	Total - 19850	Last 24 Hrs - UNK/NR
SE LAND, ME LAND	Months Since - UNK/NR	Make/Model - 2400	Last 30 Days - 6643
	Aircraft Type - UNK/NR	Instrument - UNK/NR	Last 90 Days - 13725
		Multi-Eng - 18600	Rotorcraft - UNK/NR

Instrument Rating(s) - AIRPLANE

-----Narrative-----

ON NOVEMBER 13, 1986, THE REAR MAIN SPAR OF THE RIGHT WING FAILED AS DELTA FLT 194 TOUCHED DOWN ON RNY 29 AT NEWARK AIRPORT. THE PILOTS STATED THAT THERE WAS MODERATE TURBULENCE ON FINAL APPROACH AND INITIAL TOUCHDOWN WAS ON THE RIGHT MAIN GEAR FIRST. THE TOUCHDOWN WAS FIRM BUT NOT HARD WHICH WAS CONFIRMED FROM THE 1.4G RECORDED ON THE DFDR. THE 1.4G FORCE IS WELL WITHIN THE LANDING GEAR CERTIFICATION LIMITS. THE SPAR WEB FAILURE WAS CAUSED BY A FATIGUE CRACK THAT ORIGINATED AT A "HI - LOC" FASTENER HOLE LOCATED AT THE LOWER INBOARD CORNER OF A DOUBLER THAT SURROUNDS THE FUEL FILLER VALVE WHICH IS MOUNTED VERTICALLY ON THE SPAR WEB. THE FATIGUE ZONE IN THE SPAR WEB HAD PROGRESSED ABOUT 6 3/4 INCHES BEFORE THE WEB FAILED AS THE AIRPLANE TOUCHED DOWN. THE FRACTURE IN THE SPAR WEB EXTENDED DIAGONALLY DOWNWARD AND OUTBOARD AT 45 DEGREES FROM INBOARD WING STATION 241.0 TO INBOARD STATION 293.5. THE FLIGHT CREW DID NOT REPORT ANY AIRPLANE MALFUNCTION DURING THE FLIGHT.

Brief of Accident (Continued)

File No. - 2331

11/13/86

NEWARK, NJ

A/C Reg. No. N714DA

Time (Lcl) - 1225 EST

Occurrence AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation LANDING - FLARE/TOUCHDOWN

Findings(s)

1. WING - FAILURE, PARTIAL
2. WING - FATIGUE
3. AIRCRAFT/EQUIPMENT, INADEQUATE DESIGN - MANUFACTURER

----Probable Cause----

The National Transportation Safety Board determines that the Probable Cause(s) of this accident is/are finding(s) 2,3