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16.Abstract

About 0734 e.d.t., on September 11, 1974, Eastern Air Lines, Inc., Flight 212, crashed 3.3 statute miles short of runway 36 at Douglas Municipal Airport, Charlotte, North Carolina. The flight was conducting a VOR DME nonprecision approach in visibility restricted by patchy dense ground fog. Of the 82 persons aboard the aircraft, 11 survived the accident. One survivor died of injuries 29 days after the accident. The aircraft was destroyed by impact and fire.

The National Transportation Safety Board determines that the probable cause of the accident was the flightcrew's lack of altitude awareness at critical points during the approach due to poor cockpit discipline in that the crew did not follow prescribed procedures.

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AIRCRAFT ACCIDENT REPORT

EASTERN AIR LINES, INC.
DOUGLAS DC-9-31, N8984E
CHARLOTTE, NORTH CAROLINA
SEPTEMBER 11, 1974

ADOPTED: MAY 23, 1975

NATIONAL TRANSPORTATION SAFETY BOARD
Washington, D. C. 20594
REPORT NUMBER: NTSB-AAR-75-9

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SYNOPSIS

About 0734 e.d.t., on September 11, 1974, Eastern Air Lines, Inc., Flight 212, crashed 3.3 statute miles short of runway 36 at Douglas Municipal Airport, Charlotte, North Carolina. The flight was conducting a VOR DME nonprecision approach in visibility restricted by patchy dense ground fog. Of the 82 persons aboard the aircraft, 11 survived the accident. One survivor died of injuries 29 days after the accident. The aircraft was destroyed by impact and fire.

The National Transportation Safety Board determines that the probable cause of the accident was the flightcrew's lack of altitude awareness at critical points during the approach due to poor cockpit discipline in that the crew did not follow prescribed procedure.

1. INVESTIGATION

1.1 History of the Flight

On September 11, 1974, Eastern Air Lines, Inc., Flight 212, a Douglas DC-9-31, N8984E, operated as a scheduled passenger flight from Charleston, South Carolina, to Chicago, Illinois, with an en route stop at Charlotte, North Carolina.

The flight departed Charleston at 0700 1/ with 78 passengers and 4 crewmembers on board. It was cleared to Charlotte on an instrument flight rules (IFR) flight plan.

From 0721:46 to 0725:01, Airport Terminal Information Service (ATIS) information was recorded on the cockpit voice recorder (CVR) tape. ATIS was broadcasting information "Uniform," 2/ as follows:

1/ All times herein are eastern daylight, based on the 24-hour clock.
2/ ATIS - The continuous broadcast of recorded noncontrol information in selected high activity terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential but routine information. "Uniform" was the phonetic designator for information being broadcast at the time of the approach of Flight 212.

"0724...Charlotte weather, sky partially obscured; estimated ceiling, 4,000 broken, 12,000 broken; visibility, 1½ in ground fog; temperature, 67°; wind, 360° at 5; altimeter, 30.16. VOR 36 approach in use. Landing and departing runway 36. All arriving aircraft make initial contact with Charlotte approach east, one two four point five. Runway 5 approach lights decommissioned. Inform the controller that you have information 'Uniform.'"

About 0722, Atlanta Air Route Traffic Control Center (ARTCC) cleared Flight 212 to descend to 8,000 feet. 3/ The clearance was acknowledged by the captain. About 50 seconds later, the CVR recorded the sound of the autopilot disconnect.

From 0723:23 to 0724:07, the CVR recorded conversations between the Eastern Air Lines Operations Service Agent at Charlotte and three other Eastern Flights en route to Charlotte. These conversations concerned the Eastern required in-range check procedure. About 10 minutes before the accident, the crew of Flight 212 also conducted this check in an abbreviated form.

At 0725:01, Atlanta ARTCC requested Flight 212's altitude. The captain responded, "We're slowing at ten." Atlanta ARTCC cleared the flight to contact Charlotte and stated the flight was "...descending to eight." At 0725:18, Charlotte Approach Control directed, "fly heading zero four zero, vectors to VOR, 4/ final approach course runway three six, descend and maintain six thousand." The captain acknowledged the clearance. He then accomplished the in-range checklist and announced, "in-range." The first officer, who was flying the aircraft, responded, "OK."

From a few seconds after completion of the in-range checklist until 0726:56, the flightcrew conversed on several nonoperational subjects.

At 0727:13 the flight was cleared by approach control to turn left to a heading of 360°. These instructions were acknowledged by the captain. At 0727:13, the first officer requested, "Flaps 5° please, sir."

From 0728:27 to 0728:49, the flightcrew conversed on nonoperational subjects. During this conversation, at 0728:37, the CVR recorded a sound similar to an altitude alert tone. 5/ At the same time the flight data recorder (FDR) showed that the aircraft was approaching 6,000 feet.

At 0728:53, Charlotte cleared the flight to "turn left heading two four zero." Shortly thereafter, the flight received further clearance to "descend and maintain four thousand." The captain acknowledged both clearances.

3/ All altitudes are mean sea level unless otherwise indicated.
4/ VOR - Very High Frequency Ormidirectional Range.
5/ The altitude alert tone, in conjunction with altitude alert warning lights, alerts the crew when the aircraft is within 750 feet and 250 feet of an altitude set by the crew during ascent or descent. The tone has a 2-second duration.

At 0729:05, the first officer requested that the flaps be extended to 15°. The recorded airspeed was about 220 kn.

At 0729:14, the flight was requested to contact Charlotte on another frequency. The captain acknowledged the request, and at 0729:30, he contacted the Charlotte final controller and stated "...descending to four, we're turning to two forty." The final controller requested the flight to continue on the heading and "descend and maintain three thousand." The captain acknowledged the transmission.

From 0729:46 to 0730:10, the flightcrew, again, conversed on several nonoperational subjects.

At 0730:23, the final controller requested the flight to "...reduce to 160 knots." The captain acknowledged the request. The FDR showed that speed was reduced from 188 kn to 165 kn over the ensuing 1-minute period.

The nonoperational conversation between the crewmembers continued until 0731:07. The conversation was interrupted only by a sound similar to that of the pitch trim at 1730:28 and again at 1730:58.

At 0731:09, the final controller cleared the flight to "...turn right, heading 350° cleared VOR 36 approach, you're six miles south of Ross Intersection." 6/ The captain acknowledged the clearance.

At 0731:31, the CVR recorded a sound similar to an altitude alert signal. At the same time, the FDR recorded the aircraft approaching 3,000 feet.

At 0731:36, the captain said, "There's Carowinds, 7/ I think that's what that is."

At 1731:39, Charlotte Approach Control cleared flight 212 to resume normal speed and cleared them to contact the tower. The FDR showed that the speed increased from 165 kn to about 188 kn over the next minute.

Eight seconds later the flight contacted Charlotte Tower and said that they were about 5 miles south of Ross. The flight was advised to continue the approach and that they were No. 2 for landing.

At 0731:54, the altitude alert sounded. The FDR indicated that the aircraft was at an altitude of 2,750 feet.

6/ Ross Intersection - The final approach fix for a VOR approach to runway 36. The intersection is 4.4 nmi from the runway threshold.

7/ Carowinds Tower is a tower in an amusement park located about 1 3/4 miles SSW of the Ross Intersection. It rises to 340 feet above the ground level, which is 979 feet m.s.l. An observation elevator, described as "doughnut-shaped," travels up and down the tower. There are flashing red lights and high intensity white strobe lights on the tower with an intensity of 2,000,000 candelas that can be seen on the brightest day.

At 0732:01, the captain stated, "Ross, five point five, eighteen hundred." The final approach fix (FAF), Ross Intersection, is 5.5 nmi from the Charlotte VOR and the minimum crossing altitude at the fix is 1,800 feet.

At 0732:13, the captain said, "Carowinds." The first officer questioned it by saying, "Ah, that tower, would that tower be it or not?" The captain replied, "** 8/ Carowinds, I don't think it is. We're too far, too far in. Carowinds is in back of us." The first officer agreed, "I believe it is." Then the captain said, "...that looks like it. You know it's ** Carowinds." There were a few seconds of unintelligible conversation after which the first officer said, "It's supposed to be real nice." The captain then said, "Yeah, that's the tower." At this time, the first officer requested gear down and the before-landing checklist, and the captain said, "That's what that is." The sound of gear extension was heard at 0732:37.

At 0732:41, the steady tone of the terrain warning 9/ sounded indicating that the aircraft was 1,000 feet or less above the ground. The aural warning was silenced.

At 0732:48, the captain said, "That's Carowinds there."

From 0732:52 until 0733:07, sounds recorded on the CVR show that items on the before-landing checklist were being accomplished.

At 0733:12, one of the flight crewmembers said, "Three ninety-four." This figure corresponds to the minimum descent altitude above touchdown elevation for the approach. The other flight crewmember acknowledged the figure.

At 0733:17, the captain said, "There's ah, Ross. Now we can go down." The first officer then requested, "How about 50°, please." The captain replied, "50." Clicks heard on the CVR indicate that the flap handle was moved. At that time, the FDR showed the aircraft's altitude was about 1,480 feet.

At 0733:36, the captain advised Charlotte Tower that they were by Ross Intersection. The local controller cleared the flight to land on runway 36. The last radio transmission from the flight was the acknowledgement, "Alright," at 0733:46.

According to the CVR, at 0733:52, the captain said, "Yeah, we're all ready," followed shortly thereafter by "All we got to do is find the

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8/ ** - Unintelligible word.

9/ The terrain warning system is activated when the aircraft descends to 1,000 ft. above the ground as sensed by the radio altimeter. It uses the same tone and lights as the altitude alerting system. The tone and the lights are continuous until cancelled by either pilot.

airport." At 0733:57, the first officer answered "Yeah." About one-half second later both captain and first officer shouted. At 0733:58, initial impact was recorded.

The aircraft struck some small trees and then impacted a cornfield about 100 feet below the airport elevation of 748 feet. The aircraft struck larger trees, broke up, and burst into flames. It was destroyed by the impact and ensuing fire.

The aircraft crashed about 1.75 statute miles from Ross Intersection and about 3.3 statute miles short of the threshold of runway 36.

The accident occurred during daylight hours at 35° 09' 14" N. latitude and 80° 55' 34" W. longitude. Eleven persons who saw the aircraft just before the crash agreed that (1) the aircraft was much lower than those they were accustomed to seeing or hearing on this approach and (2) other than the low altitude and the loud engine noise associated with the flight, there was nothing unusual about the appearance of the aircraft.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Other
Fatal	2	69	0
Nonfatal 10/	1	9	0
None	1	0	

Of the 82 occupants of the aircraft, 11 passengers and 2 crewmembers survived the crash and fire. One passenger died 3 days after the crash, and another died 6 days after the crash.

1.3 Damage to Aircraft

The aircraft was destroyed.

1.4 Other Damage

None.

1.5 Crew Information

The crew of Flight 212 was certificated and trained for the flight. (See Appendix B.)

10/ One passenger died of his injuries 29 days after the accident. 14 CFR 430.2 defines fatalitities attributable to an accident as those occurring within 7 days of the accident. Therefore, this passenger was listed in the "nonfatal" category.

1.6 Aircraft Information

The aircraft was certificated, equipped, and maintained in accordance with Federal Aviation Administration (FAA) requirement . (See Appendix C.)

At the time of the accident, about 13,000 lbs. of jet A-1 fuel was on board. The gross weight and the center of gravity were 90,000 lbs. and 21 percent MAC, respectively. Both were within limits at the time of the crash.

1.7 Meteorological Information

Weather in the Charlotte area at the time of the accident was characterized by little or no wind, scattered clouds near 5,000 feet, and restricted visibility near the surface because of shallow, patchy ground fog.

The following terminal forecast was issued for Charlotte by the Weather Service Forecast Office at Raleigh-Durham, North Carolina, at 0540 on September 11, 1974, and was valid for 24 hours beginning at 0600:

0600-0900 - Partial obscuration, visibility -- 2 miles in ground fog; variable to partial obscuration, visibility -- ½ mile in fog; chance briefly ceiling -- 200, sky obscured with visibility -- ½ mile in fog.

0900-1100 - 25,000 thin scattered, visibility - 3 miles in haze.

The official surface weather observations at Charlotte Airport near the time of the accident were as follows:

0655 - Partial obscuration, estimated 4,000 feet broken, 12,000 feet broken, visibility -- 1½ miles in ground fog, temperature -- 67°, dew point - 65°, wind-calm, altimeter setting -- 30.16 in., fog obscuring 2/10 of sky.

0738 - Local Observation, partial obscuration, 5,000 feet scattered, visibility -- 1½ miles in ground fog, temperature -- 68°, dew point -- 66°, wind -- calm, altimeter setting -- 30.17 in., fog obscuring 2/10 of sky, aircraft accident, filed but not transmitted.

0755 - Partial obscuration, 5,000 feet scattered, visibility -- 1½ miles in ground fog, temperature -- 68°, dew point -- 66°, wind -- calm, altimeter setting -- 30.18 in., fog obscuring 2/10 of sky.

The Eastern Air Lines meteorological department issued a system forecast valid for 0355 to 1500 on September 11, 1974, which was, in part, as follows:

> "Southeast -- Patchy ground fog through Carolina's-Georgia, increasing to marginal conditions around sunrise at a few stations and burning off 1 to 2 hours after sunrise."

The company forecast continued:

> "Charlotte -- Clear or high clouds.
>
> 0700, partial obscuration, 3/4 miles haze, fog.
>
> 0900, at or above 4,000 feet and 3 miles."

Five flights preceded Flight 212 on the same morning to runway 36 without difficulty. The pilots' reports on visibility and the controllers' observations of aircraft on the final approach course to runway 36 indicated a slant range visibility between 2½ to 3 miles. According to a helicopter pilot and the captain of the aircraft that made the approach just before Flight 212, the tops of the patches of ground fog were about 450 feet above ground level.

The accident occurred during daylight; however, the accident site was obscured by dense fog.

1.8 Aids to Navigation

The Douglas Municipal Airport is equipped with a full ILS system to runway 5. Because of construction of a new runway, the runway 5 approach light system was decommissioned on May 20, 1974. With no approach lights available, the runway visual range (RVR) minimum for the ILS is 4,000 feet.

A VORTAC, 11/ located on the airport about 1.1 nmi from the approach end of runway 36, is used for nonprecision approaches to the runway. The VOR 36 approach is made inbound on the 173° radial to cross the Ross Intersection, located at 5.5 nmi from the VORTAC, at about 1,800 feet (1,074 feet above the touchdown zone). After an aircraft passes Ross, descent is authorized to a minimum descent altitude (MDA) of 1,120 feet (394 feet above the touchdown zone). (See Appendix D.)

The flightcrews of aircraft which landed on runway 36 before and after the accident did not report malfunctions of any navigational aid serving that runway. Postaccident flight checks of the VORTAC facility showed no indication of system malfunction or misalignment.

11/ VORTAC - collocated VOR and TACAN (ultrahigh frequency tactical air navigation aid) facility.

1.9 Communications

No communications difficulties were reported between the flightcrew and ground stations.

Air traffic control operations were being conducted in accordance with prescribed procedures and standard practices, except that, contrary to procedures, Charlotte Approach Control did not ascertain that Flight 212 had received the current ATIS information "Uniform" and no current weather information was transmitted to the flight by the approach controller.

The controller's explanation for this ATC procedural irregularity was that he thought the pilot had stated on initial contact that the flight had information "Uniform." Flight 212 did not make that statement to the approach controller; however, the CVR recorded the broadcast of information "Uniform" before the flightcrew made initial contact with approach control. In addition, the first officer later stated that he heard "Uniform" broadcast.

1.10 Aerodrome and Ground Facilities

The Douglas Municipal Airport is located 5 statute miles west of downtown Charlotte. The airport is served by two runways -- 5-23 and 18-36.

Runway 36, which is 7,845 feet long and 150 feet wide, was the active runway at the time of the accident. The runway is equipped with high intensity runway lights, runway end identifier lights, and a visual approach slope indicator. The elevation of the touchdown zone is 726 feet.

The terrain near the airport is generally rolling countryside with lower elevations to the south.

1.11 Flight Recorders

The aircraft was equipped with a Fairchild Model A-100 cockpit voice recorder, serial No. 2313. Although the recorder was damaged extensively by fire, the recorder tape was in excellent condition. A normal readout of the tape was obtained.

The aircraft was also equipped with a Sundstrand Data Control, Model FA-542, flight data recorder, serial No. 3678. The FDR was found intact and undamaged. The Inconel foil recording medium was not damaged, and three of the four recorded parameters were legible. A slight malfunction in the foil takeup drive system caused intermittent gaps on all traces. The malfunction rendered the vertical acceleration trace unreadable, but caused little difficulty in the readout of the other paramaters.

Both recorders were located in the aft section of the aircraft. Data taken from the FDR and the CVR were combined into a descent profile and a flight track presentation. (Appendixes E and F.)

1.12 Wreckage

The aircraft struck the ground in an open field. The field was surrounded by dense woods and underbrush.

At initial impact, the right wingtip struck and broke tree limbs about 25 feet above the ground. About 16 feet above the ground, the left wing struck and sheared a cluster of pine trees.

The left main landing gear wheel struck the ground 110 feet past the initial impact point. The right main landing gear wheel struck the ground 5 feet farther down the field. The aircraft's final descent angle was calculated to have been 4.5° and its bank attitude 5.5° left wing down. The ground elevation was 620 feet. Wheel imprints were continuous for 50 feet and increased to a depth of 18 inches.

Broken red glass from the lower fuselage rotating beacon was found within the tail skid and aft fuselage ground marks.

As the aircraft continued 198 feet beyond the initial impact point, the left wingtip contacted the ground and made a mark 18 feet long.

After the aircraft had traveled 550 feet beyond the initial impact point, the left wing contacted other trees and the wing broke in sections; at this point, ground fire began and spread in the direction of travel of the aircraft until the aircraft came to rest. The right wing and right stabilizer were sheared off.

The remainder of the aircraft -- the fuselage and part of the empennage section -- continued through a wooded area. The fuselage breakup was more severe in this area.

The aircraft wreckage came to rest in a ravine 995 feet from the initial impact point. The cockpit section came to rest on a magnetic heading of 310°; the aft fuselage section came to rest on a magnetic heading of 290°. The wreckage area was 995 feet long and 110 feet wide. No parts of the aircraft were found outside the main wreckage area. (See Appendix G.)

The nose landing gear was separated from the fuselage and was found in the extended position. The nose gear was not damaged by fire.

The main landing gears were separated from their attach structure and were extended. The right main gear had been damaged considerably by fire; the left main gear received minor fire damage.

The outer fan exit ducts of the front compressors on both engines showed evidence of rotational twisting in the direction of fan rotation. The fourth-stage turbine blades of both engines were intact and were not damaged. Neither engine casing had been penetrated. The thrust reversers of both engines were stowed.

Neither engine revealed evidence of a malfunction within the fuel pump and fuel control. The main oil screen, the pressurizing and dump valve screen, the fuel control unit screen, and the low pressure fuel filter of both engines were free of foreign debris.

All engine damage noted appeared to have been caused by impact and subsequent fire. There were no indications that the auxiliary power unit was operating at the time of impact.

All the flight control surfaces were accounted for.

No evidence was found to indicate an in-flight fire, explosion, or bird strike.

All observed fractures were typical of those caused by overloads.

Examination of the remains of the three fuel tanks revealed no indication of explosion or internal fire. There was no evidence of fuel tank skin bulging.

The actuators for the wing leading edge slats and the trailing edge flaps were measured; the slats were extended and the flaps were at the 50° position. The spoilers were retracted.

Most of the aircraft's systems and instrumentation were destroyed. The recovered communications control equipment was set to the correct frequencies for the approach.

The airspeed module syncro in the air data computer corresponded to 129 kn. The fine altitude syncro, corrected to an altimeter setting of 30.16 inches Hg., corresponded to 553 feet.

The barometric corrected output in the output syncro to the altitude alert control module from the captain's No. 2 (lower) altimeter was 618 feet. The drum of the captain's No. 1 (upper) altimeter, which is set to read height above field elevation, had an impact mark one-eighth of an inch below the zero reference line. Examination with an electron microscope showed that paint in the impact mark was of the same size and shape as a paint chip from the back of the altitude point. This mark corresponds to an altitude of about -150 feet.

Both distance measuring equipment (DME) units had been set to the correct frequency (Channel 43) and the distance measurements on the modules were 4.8 miles.

Portions of the static system, mainly tubes and fittings, were examined for trapped moisture or other unusual conditions; none were found. The captain's static selector valve switch in the cockpit was positioned to "normal."

All cockpit electrical system controls and circuit breakers located on the overhead switch panels were destroyed by fire.

1.13 Medical and Pathological Information

Postmortem examination of the captain disclosed no evidence of incapacitating disease, drugs, or alcohol.

Of the 71 persons who died as a result of the accident, 31 passengers and 1 crewmember died of impact injuries. Twenty-five passengers died of burns and smoke inhalation; seven passengers died of burns only; one passenger died of smoke inhalation. The remaining five passengers and the flight attendant located in the aft section of the fuselage died because of a combination of factors.

The passenger who survived the crash, but who died 29 days later, received impact injuries and severe burns.

The first officer received severe impact injuries to both legs and minor body lacerations. Physical examination disclosed no evidence of incapacitating disease, drugs, or alcohol.

The flight attendant in the forward cabin area escaped without injury.

Survivors who had been wearing double-knit garments of manmade fibers reported that these materials melted, adhered to their skin, and could not be removed. One survivor stated that half of his burns were caused by the double-knit material.

1.14 Fire

About 0735, after losing contact with the flight and sighting a column of smoke, the Charlotte tower controller sounded the crash alert and notified the Airport Fire Department Station Commander. Three crash trucks and the station commander's vehicle departed immediately toward the crash site.

Some difficulty was encountered in locating the wreckage, but with the aid of local residents and motorists, the first fire vehicle arrived on the scene at 0740. Further difficulty in approaching the crash was encountered because of the terrain around the accident site.

At 0741, the Steele Creek Volunteer Fire Department was notified of the accident. Their trucks and emergency equipment were on the scene in 4 to 5 minutes.

Rescue activities were confined to those persons outside the aircraft because there were no signs of life from within the aircraft wreckage when the fire and rescue equipment arrived. The first survivors were transported to the hospital at 0748. Within 45 minutes of the accident, all survivors had been removed to hospitals.

The fire was under control within minutes after the arrival of the first vehicle, and rescue and firefighting efforts were completed by 1030.

1.15 Survival Aspects

This was a partially survivable accident. Only a small section of the cabin, near the tail of the aircraft, retained its structural integrity. Most of the structure was destroyed and, in most cases, the occupant restraint system failed. Finally, fire occurred in the cabin during the breakup of the aircraft and continued to burn until extinguished by the fire department.

All survivors in the rear of the aircraft were either thrown out of the wreckage or escaped through holes in the fuselage. The surviving passenger and the two surviving crewmembers in the front of the aircraft escaped through a cockpit window.

The forward cabin entry door was found partially open but was blocked by a fallen tree. Because of the position of the wreckage, the ground blocked the forward galley door. The center fuselage overwing escape windows were destroyed by fire. The auxiliary exit in the tail of the aircraft was useable; however, it was not used for escape.

1.16 Tests and Research

None.

1.17 Other Information

The following are excerpts from Eastern Air Lines' manual:

> "Eastern Air Lines DC-9 Flight Operations Procedures - Altimeters
>
> Altimeters on standard EAL installations are a No. 1 (upper) and a No. 2 (lower) for the captain and a No. 1 for the first officer.
>
> "An altimeter check will be made at station of origin and at each crew or aircraft change as follows:

1. No. 1 altimeters, set barometric scale to Field Pressure setting (Kollsman) as reported by ground station; check variation of altitude indication from zero.

2. No. 2 altimeter, set barometric scale to most recently reported sea level altimeter setting for the field; check variation of altitude indication from field elevation."

"In-Range contact will be made directly with the station of intended landing about 15 minutes out and below 18,000 feet in order to obtain:

1. Field pressure (QFE) in feet and millibars, and altimeter setting (QNH) from the ground station.

2. The flight will respond with No. 1 altimeter setting in inches Hg.

3. The ground station will verify altimeter setting and provide fuel information."

"<u>En Route Procedures</u>

During descent, the pilot not flying will call out the assigned altitude upon going through the last 1,000-foot level prior to the assigned level. The last 1,000 feet should be at a target rate of 500 feet per minute."

"<u>Callouts: Over the Final Approach Fix (FAF)</u>

On IFR approaches, the pilot not flying will call out the altitude (QFE), deviation from 'bug' speed as appropriate, and the result of the flag scan."

"<u>At 1,000 Feet above Field Elevation (QFE)</u>

At VFR approaches, the pilot not flying will call out altitude and deviation from 'bug' speed."

"<u>At 500 Feet Above Field Elevation (QFE)</u>

The pilot not flying will call out altitude, deviation from 'bug' speed, rate of descent, and on instrument approaches only, the result of the flag scan."

"100 Feet Above Minimum (IFR)

The pilot not flying will call out 100 feet above minimum."

"Nonprecision Approaches

The gear should be extended and the final checklist completed prior to final fix or start of final descent to the MDA. The estimated ground speed should be used to determine the time from final fix to touchdown. Use this time and the altitude above touchdown when over the final fix to compute the rate of descent necessary in order to get down in time to land. The rate of descent made good should be at least the average required but not to exceed 1,000 feet per minute.

The pilot not flying should keep track of the time, MDA and MAP. Callouts that are peculiar to the nonprecision approach are:

1. Over final fix-time started.

2. 100 feet above MDA."

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The aircraft was certificated, equipped, and maintained according to FAA requirements and regulations. The gross weight and center of gravity were within prescribed limits during takeoff at Charleston and during the approach at Charlotte.

The aircraft's powerplants, airframe, electrical and pitot/static instruments, flight controls, and hydraulic and electrical system were not factors in the accident. There was no evidence of in-flight fire, bird strike, or explosion.

The flight crewmembers were certificated and qualified in accordance with company and FAA requirements and regulations.

The accident cannot be attributed to malfunctions of ground facilities, the aircraft, or its systems. Although there was a minor air traffic control deficiency concerning acknowledgement of receipt of ATIS information, ATC procedures were not involved in the accident. Therefore, the Safety Board focused its analysis on the operational, weather, and human-factor aspects of the approach and the survivability of the accident.

The Approach

The first officer flew the aircraft from Charleston and was operating the flight controls throughout the descent and approach into Charlotte. The captain, in performing duties assigned to the pilot not flying the aircraft, made the radio transmissions to ARTCC and approach control and accomplished items on the In-Range and Before Landing checklists.

During the descent, until about 2 minutes and 30 seconds prior to the sound of impact, the flightcrew engaged in conversations not pertinent to the operation of the aircraft. These conversations covered a number of subjects, from politics to used cars, and both crewmembers expressed strong views and mild aggravation concerning the subjects discussed. The Safety Board believes that these conversations were distractive and reflected a casual mood and lax cockpit atmosphere, which continued throughout the remainder of the approach and which contributed to the accident. The overall lack of cockpit discipline was manifested in a number of respects, as discussed below, where the flightcrew failed to adhere to recommended or required procedures.

At 0732:13, as the flight intercepted the inbound VOR radial for the approach, the flightcrew commenced a discussion of Carowinds Tower, which was located ahead and to the left of the projected flightpath. This discussion lasted 35 seconds, during which 12 remarks were made concerning the subject. It is apparent that, during this discussion, a considerable degree of the flightcrew's attention was directed outside the cockpit. This particular distraction assumes significance because, during this period, the aircraft descended through 1,800 feet (1,074 feet above touchdown elevation), the altitude which should have been maintained until it crossed Ross Intersection, the final approach fix (FAF). At the end of the 35-second period, the aircraft was still 1.5 nmi short of the FAF.

It is noteworthy that at 0732:41, during the latter part of the discussion regarding Carowinds Tower, the terrain warning alert sounded in the cockpit, signifying that the aircraft was 1,000 feet above the ground. This warning should have been particularly significant to the flightcrew, if heeded, since it would have made them aware that the aircraft had prematurely descended through the FAF crossing altitude of 1,074 feet above touchdown elevation. Obviously, the crew was not so alerted, since the descent continued. Based on pilot testimony taken at the hearing, it appears that the crew's disregard of the terrain warning signal in this instance may be indicative of the attitudes of many other pilots who regard the signal as more of a nuisance than a warning. If this is indeed the case, the Board believes that airline pilots should reexamine their attitudes toward the terrain warning alert, lest the purpose for which the device was installed be defeated. Although the repetitious sounding of the alarm may have a tendency to undermine its effectiveness, this acci-

dent points up the importance of devices designed to enhance altitude awareness at critical points in an instrument approach. 12/

Within seconds after the discussion of Carowinds Tower terminated at 0732:48, the rate of descent of the aircraft was slowed from about 1,500 feet per minute to less than 300 feet per minute. Such a reduction in the descent rate may have been a reflection of the switch of the first officer's attention from outside the cockpit to the instrument panel. Prior to the reduction in the rate of descent, the airspeed had increased to 188 knots, which clearly seems excessive in view of the fact that the flight had approached to within a mile of the FAF. 13/ As the rate of descent decreased, the airspeed also decreased, from 188 knots to 168 knots. At 0733:24, the aircraft passed over Ross Intersection (the FAF) at an altitude of 1,350 feet (624 feet above field elevation), which is 450 feet below the prescribed crossing altitude. The captain did not make the required callout at the FAF, which should have included the altitude (above field elevation), deviation from the "Bug" or V_{ref} speed, and the result of the flag scan. Although shortly before crossing the FAF, one of the pilots stated "three ninety four," such statement obviously was not a callout of the altitude, but rather a refecence to the MDA in height above field elevation.

While in the vicinity of Ross Intersection, the first officer asked for 50 degrees of flaps; this request was carried out by the captain. The airspeed at this time was 168 knots, as contrasted with the recommended procedure which calls for the airspeed when passing over the FAF to be in the area of V_{ref}, which in this instance was 122 knots. This discrepancy is a further manifestation of the overall unstabilized nature of the approach.

Shortly after passing Ross Intersection, the aircraft passed through an altitude of 500 feet above field elevation, which should have prompted the captain to call out altitude, deviation from "bug" speed, and rate of descent. No such callout was made, nor was the required callout made when the plane descended through an altitude 100 feet above the MDA of 394 feet above the field elevation. The descent rate, after passing Ross, increased to 800 feet per minute, where it stabilized until approximately 7 to 8 seconds prior to impact, when it steepened considerably.

The Board has been unable to determine the precise reason for the almost total lack of attitude awareness on the part of the crew throughout

12/ Subsequent to the accident, Eastern amended its procedures to require that, when the terrain warning signal sounds, the callout at 1,000 feet above airport elevation will be made. Another requirement made by Eastern is that the radio altimeter will be set at MDA or at 500 feet when the landing is being made on runways not served by an approach procedure.

13/ We also note that the recommended maneuvering speed for 15 degrees of flaps, which had been extended several minutes previously, is 160 knots.

the approach. It is possible that the crew, because of the extended duration of flight in VMC over a low, patchy fog bank through which intermittent ground contact was possible, may have relaxed their instrument scan and relied more heavily upon visual cues to fly the approach. Such a possibility is consistent, not only with the discussion of Carowinds Tower described above, but also with the captain's remark, shortly before impact, that "All we got to do is find the airport," and the first officer's response of "Yeah." Ultimately, when the aircraft penetrated the dense fog around the accident site, visual reference would have been lost and a switch to instrument flight would not have been possible within the available time. The most likely explanation of why Flight 212 was unable to establish visual contact with the runway environment, whereas other flights were able to do so and thereby complete the approach, is that Flight 212, flying at a lower altitude, initially entered the fog bank at a point farther from the runway threshold and thus had a greater slant-range distance through which to sight the runway markings through the fog.

Another possible reason for the crew's lack of altitude awareness involves the interrelationship between QNH (above sea level) and QFE (above field elevation) altitudes during the approach. When the aircraft came within range of Charlotte, and in accordance with Eastern's procedures, the No. 1 altimeters on both the captain's and the first officer's instrument panels were set to QFE, while the No. 2 (or lower) altimeter on the captain's panel was set to QNH. At 0732:01, or 12 seconds before the commencement of the discussion concerning Carowinds Tower, the captain, in briefing the first officer on the upcoming FAF, stated "Ross, five point five eighteen hundred." The fact that the captain gave the crossing altitude in the m.s.l. figure, rather than the QFE figure of 1,074 feet, was obviously not sound operating practice since the crew's primary altimeters were set for QFE. The captain's use of the 1,800-foot figure was probably influenced by the fact that the m.s.l. altitude on the approach plate is depicted in larger, bolder type than the QFE altitude. Nevertheless, the Board believes it is necessary for pilots to take particular care to insure that not just altitude callouts but all altitude references during an approach are made in terms of QFE figures when a system such as this is being utilized.

The first officer may have accepted the 1,800 feet as a QFE figure, particularly since his attention was diverted by the Carowinds Tower discussion and he may not have cross-referenced his own approach plate. He recalled during the testimony that, somewhere in the vicinity of Ross Intersection, he was 130 feet low (below 1,800 feet) and that the pointer on his altimeter was between the numbers 6 and 7. It is possible that the first officer, when his attention refocused on the instrument panel following the Carowinds Tower discussion, saw the pointer on the altimeter at 1,670 and, not observing the 1,000 foot window and with the 1,800-foot figure provided by the captain still in his mind, assumed the aircraft was at 1,670 feet QFE and thus only 130 feet below the FAF crossing altitude. This assumption in turn may have led him to conclude that the

aircraft still had almost 1,300 feet to lose prior to reaching MDA, and he conducted the remainder of the approach accordingly. The captain may likewise have believed the aircraft was 1,000 feet higher above the field elevation than it actually was, which would mean that, in his mind, the plane never reached MDA or 100 feet above MDA, which would further explain why these callouts were never made. Additionally, the captain may have failed to detect the discrepancy between the prescribed and actual altitudes because of his preoccupation with the checklist and with looking outside the cockpit.

It should be emphasized that the possible explanation discussed immediately above is based not only on evidence that is tenuous, at best, but also on the inferences to be drawn from such evidence as to what thought processes were evolving in the minds of the flightcrew. Obviously, such an explanation is, to a considerable degree, speculative in nature. It is nevertheless the intent of the Board that, by including this discussion in the report, pilots will be alerted against the possibility of lapsing into such a pattern when utilizing a QFE altimeter setting procedure. We also hasten to add that, even if it is assumed that the sequence of events described in the above discussion in fact occurred, this should be taken to reflect adversely not on Eastern's system, but rather on the flightcrew's implementation of that system in this instance. By virtue of training, experience, cockpit instrumentation, navigational aids, and approach plates, this crew was well equipped to accomplish the approach to Charlotte safely, and there is no causal factor beyond the flightcrew itself which would account for their failure to do so. This accident exemplifies the absolute necessity of strict adherence to prescribed procedures, particularly those pertaining to altitude awareness, during an instrument approach.

Survivability

Three major factors made this a partially survivable accident:

1. The occupiable area of the cabin was compromised when the fuselage broke up.

2. The intense postimpact fire consumed the occupiable area of the tail section and the entire center section of the cabin.

3. The occupant restraint system failed in many instances, even though crash forces were within human tolerances.

The cockpit area and the forward cabin were demolished by impact with trees. The tail section, which included the last five rows of passenger seats, is classed as a survivable area. However, postcrash fire created a major survival problem in this section.

Bodies of most of the aircraft occupants were found outside two of the major sections of cabin wreckage, which indicates that the passenger

restraint system was disrupted in these sections during cabin disintegration. The exception to the restraint system disruption was the tail section where most of the occupants who survived the impact died in the post-crash fire.

Only the flight attendant stationed in the forward cabin was able to offer assistance to surviving passengers in escaping from the aircraft. The captain was killed by impact. The first officer and the flight attendant in the aft cabin received disabling injuries which prevented them from aiding surviving passengers.

A passenger and the flight attendant in the forward cabin assisted the first officer in making his escape. All three escaped from the aircraft through the left cockpit sliding window.

The forward cabin doors were unuseable because of obstructions and the attitude of the aircraft. No determination of the useability of the overwing exits could be made because of fire damage.

The auxiliary exit through the tail was operable and, if it had been used, passengers could have cleared the fire area. The aft cabin flight attendant was probably unable to open the exit because of her injuries. The passengers in that area also may have been unable to open the exit either because of their injuries or because they did not know how to operate the opening mechanism.

Although the sliding window exit on the left side was the only cockpit exit used, the other cockpit window was useable.

All survivors reported that there was fire inside the cabin during the crash sequence. The insignificant levels of cyanide found in toxicological examinations indicated that the lethal factor was primarily the immediate, inital fuel fire. The effects of the fire were fatal to the passengers before the cabin interior materials had a chance to burn and generate a significant amount of cyanide gas. The fuel, which escaped from the ruptured tanks, ignited and moved along the ground with the aircraft wreckage. The fire was concentrated in the center fuselage area.

The response of the fire and rescue equipment was timely. The fire-fighting and rescue activities were performed in an exemplary manner.

2.2 Conclusions

(a) Findings

1. Malfunctions of ground facilities, the aircraft, or its systems were not a causal factor in the accident.

2. The weather in the Charlotte area was characterized by shallow, patchy ground fog such that VMC existed above the fog bank, but that visibility was drastically reduced within the fog.

3. The approach was flown manually by the first officer, while the captain handled radio transmissions and accomplished checklist items.

4. The extraneous conversation conducted by the flightcrew during the descent was symptomatic of a lax atmosphere in the cockpit which continued throughout the approach.

5. The terrain warning alert sounded at 1,000 feet above the ground but was not heeded by the flightcrew.

6. The aircraft descended through the final approach fix altitude of 1,800 feet more than 2 miles before the final approach fix was reached at an airspeed of 186 knots.

7. The aircraft passed over the final approach fix at an altitude of 1,350 feet (or 450 feet below the prescribed crossing altitude) and at an airspeed of 168 knots, as compared to the V_{ref} speed of 122 knots.

8. Required callouts were not made at the final approach fix, at an altitude of 500 feet above field elevation, or at 100 feet above the minimum descent altitude.

9. A severe postimpact fire occurred immediately after the initial impact.

10. Fatal injuries were caused by impact and thermal trauma.

11. The door exits, except for the auxiliary exit in the tail, were blocked externally.

12. Doubleknit polyester clothing increased the severity of burns.

(b) Probable Cause

The National Transportation Safety Board determines that the probable cause of the accident was the flightcrew's lack of altitude awareness at critical points during the approach due to poor cockpit discipline in that the crew did not follow prescribed procedures.

3. RECOMMENDATIONS

On October 8, 1974, the Board issued two safety recommendations to the FAA (A-74-85 and A-74-86) to initiate ways and means to improve professional standards among pilots. These recommendations cited five previous air carrier approach accidents as examples of a casual acceptance of the flight environment, and added that the Charlotte crash "reflects once again serious lapses in expected professional conduct." The FAA agrees with both recommendations and is in the process of establishing a working liaison on this subject with both airline management and air carrier pilot organizations.

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

May 23, 1975

APPENDIX A

INVESTIGATION AND HEARING

1. Investigation

The Safety Board was notified of the accident about 0755 on September 11, 1974. The investigation team went immediately to the scene. Working groups were established for operations, air traffic control, witnesses, weather, human factors, structures, maintenance records, powerplants, systems, flight data recorder, and cockpit voice recorder.

Participants in the on-scene investigation included representatives of the Federal Aviation Administration, Eastern Air Lines, Inc., Air Line Pilots Association, Douglas Aircraft Company, Pratt & Whitney Aircraft Division of United Aircraft Corporation, and the International Association of Machinists and Aerospace Workers.

2. Public Hearing

A 3-day public hearing at Charlotte, North Carolina, began on November 12, 1974. Parties represented at the hearing were: The Federal Aviation Administration, Eastern Air Lines, Inc., Air Line Pilots Association, National Weather Service, Professional Air Traffic Controller's Organization, and the Transport Workers Union of America.

APPENDIX B

CREW INFORMATION

Captain James E. Reeves

Captain James E. Reeves, 49, was employed by Eastern Air Lines, Inc., on June 18, 1956. He held Airline Transport Pilot Certificate No. 524865 with type ratings in the Convair 240/340/440, L188 and the DC-9, and commercial privileges airplane, single engine land. He had accumulated 8,876 flight-hours as pilot-in-command, which included 3,856 hours in the DC-9. He completed a 2-day recurrent training on November 26, 1973. His last proficiency check was completed on April 25, 1974, and his last line check was on August 8, 1974. On these checks he was evaluated very good and excellent respectively. His last FAA first-class medical certificate was issued on May 13, 1974, with no limitations.

He received a type rating on the DC-9 on December 14, 1967. An FAA inspector observed this check, but records reveal that no FAA observation had been made of Captain Reeves since that date.

Captain Reeves had a rest period of 13½ hours before he reported for this trip. At the time of the accident, he had been on duty about 3 hours.

First Officer James M. Daniels, Jr.

First Officer James M. Daniels, Jr., 36, was employed by Eastern Air Lines, Inc., on May 9, 1966. He held commercial pilot certificate No. 1510710 with multi-engine airplane and instrument ratings. He had accumulated approximately 3,016 flight-hours, including 2,693 hours in the DC-9. He completed his last proficiency check in a simulator on June 20, 1974. His FAA first-class medical certificate was issued on January 25, 1974, without limitations. It was still valid as a second-class medical certificate at the time of the accident.

First Officer Daniels had a rest period of 61 hours before he reported for this trip. At the time of the accident, he had been on duty about 3 hours.

Flight Attendants

Collette Watson was employed by Eastern Air Lines, Inc., on September 11, 1968. Her last recurrent training was completed on July 29, 1974.

Eugenia Kerth was employed by Eastern Air Lines, Inc., on January 7, 1970. Her last recurrent training was completed on January 17, 1974.

APPENDIX C

AIRCRAFT INFORMATION

Aircraft N8984E, a Douglas DC-9-31, serial No. 47400, was owned and operated by Eastern Air Lines, Inc. The date of manufacture was January 30, 1969, and the aircraft was delivered to Eastern on that date.

The last block overhaul was performed at Eastern Air Lines maintenance facility, Miami, Florida, January 7, 1974. A periodic service inspection (phase-4 check) was performed at the Eastern maintenance facility, Atlanta, Georgia, July 1, 1974.

Before takeoff from Atlanta, the aircraft had accumulated 16,860.6 flight-hours.

The weight and balance manifest for this flight indicated that the aircraft had been within its weight and balance limitations both at takeoff and at the time of the accident.

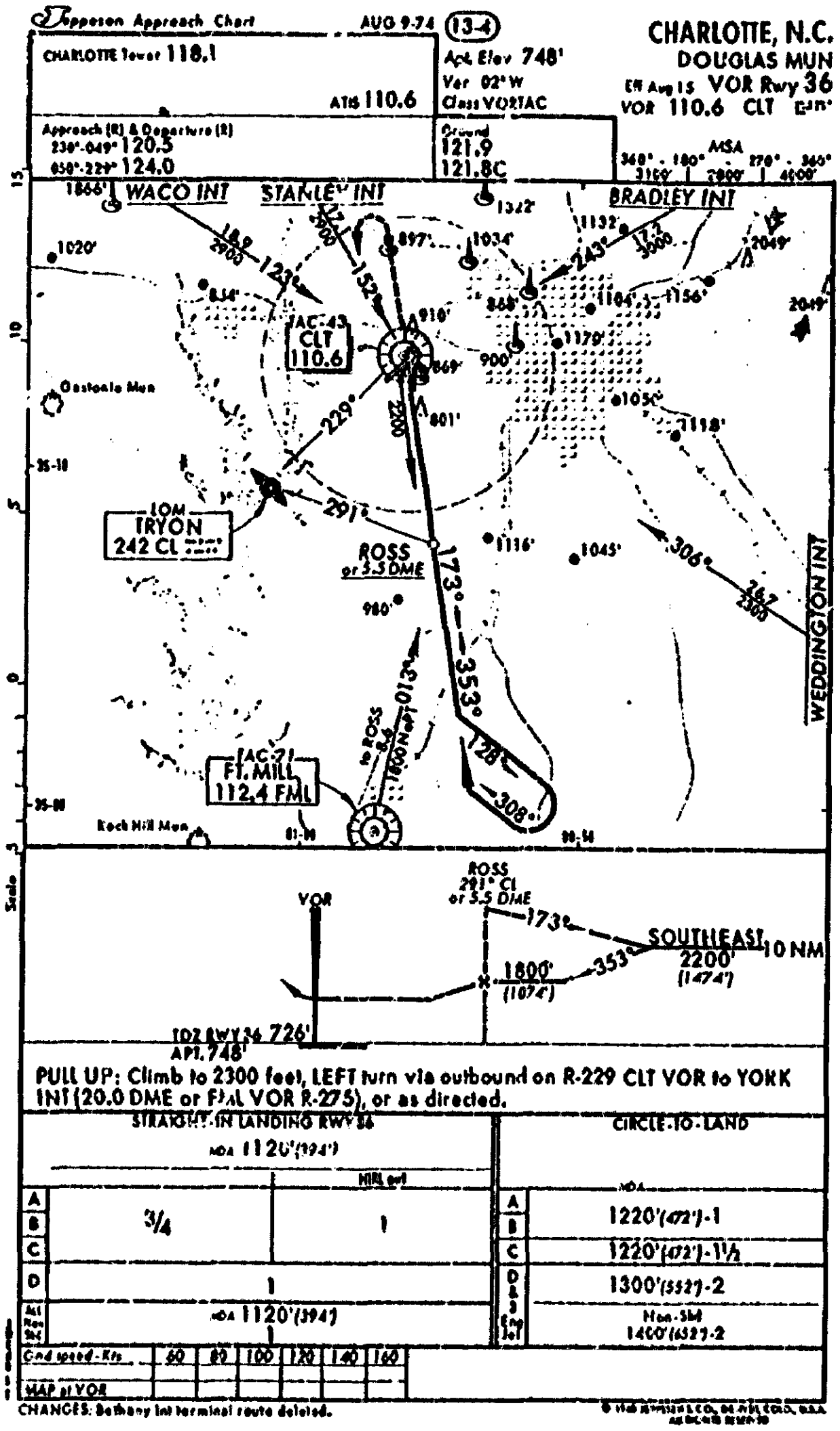
There were 37,500 lbs. of jet A-1 fuel aboard the aircraft when it departed Charleston. The planned fuel burn-off for the flight to Charlotte was 4,500 lbs. The estimated gross weight, fuel remaining, and center of gravity at the time of the accident were 90,000 lbs., 13,000 lbs., and 21 percent, respectively.

According to company records, all airworthiness directives were complied with.

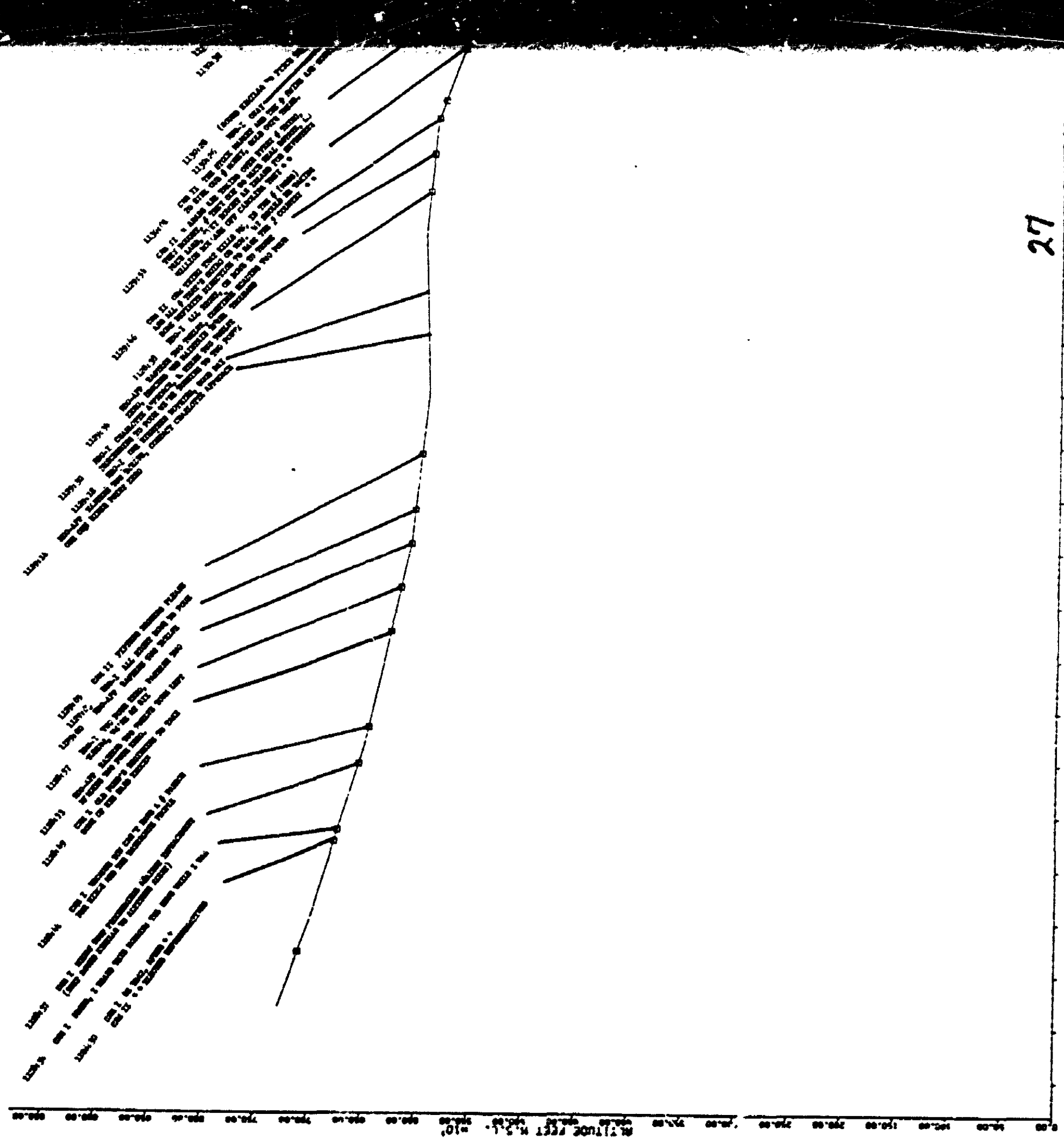
Engine Data

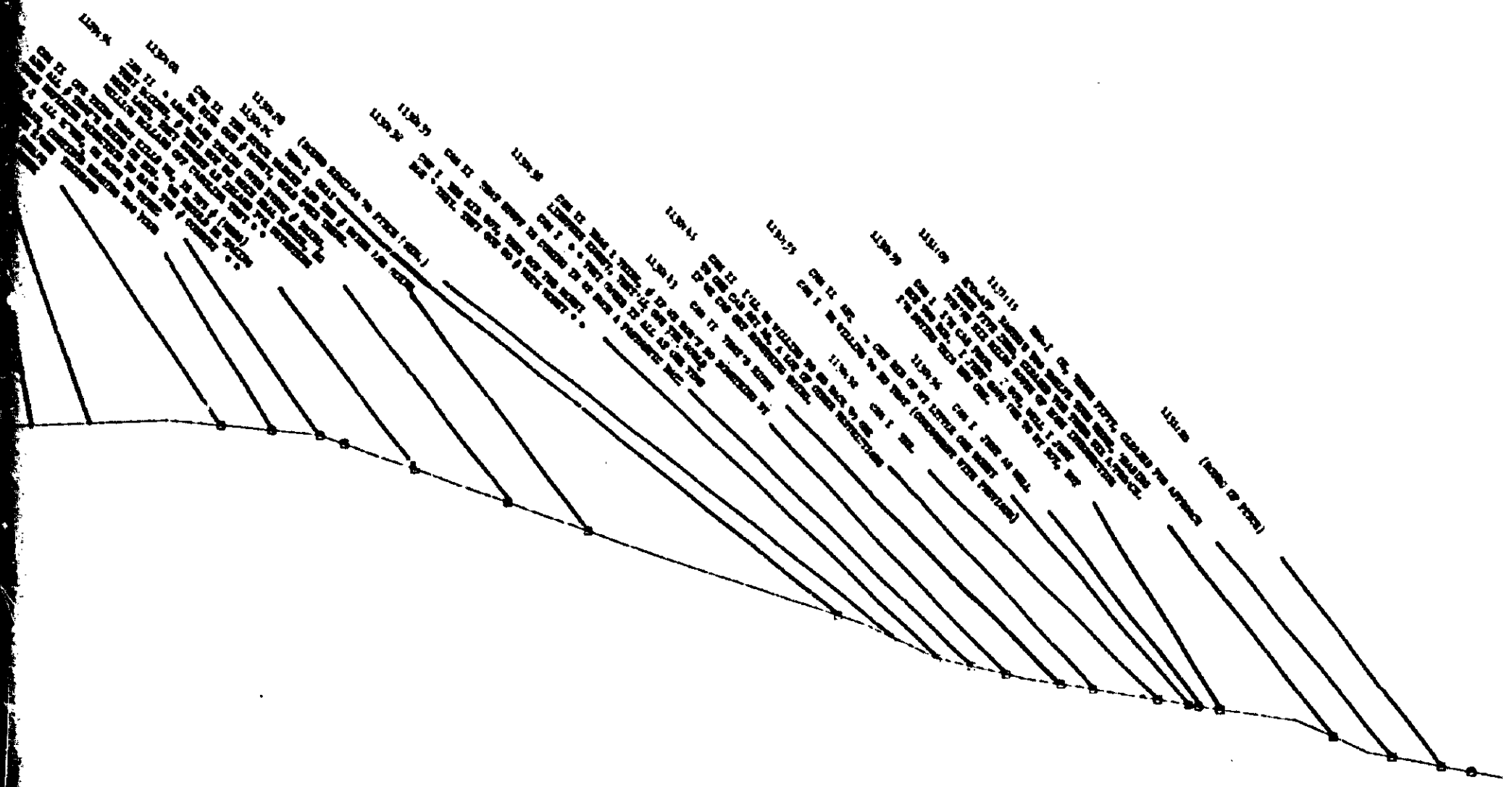
	No. 1 Engine	No. 2 Engine
Serial No.	P657318D	P657419D
Total time (hrs.)	14,988	15,677
Total thermal cycles	15,585	16,203
Time since restoration (hrs.)	3,610	5,464
Time since last shop visit (hrs.)	943	512
Thermal cycles since last shop visit	1,028	565

APPENDIX D



"ILLUSTRATION ONLY - NOT TO BE USED FOR NAVIGATIONAL PURPOSES"





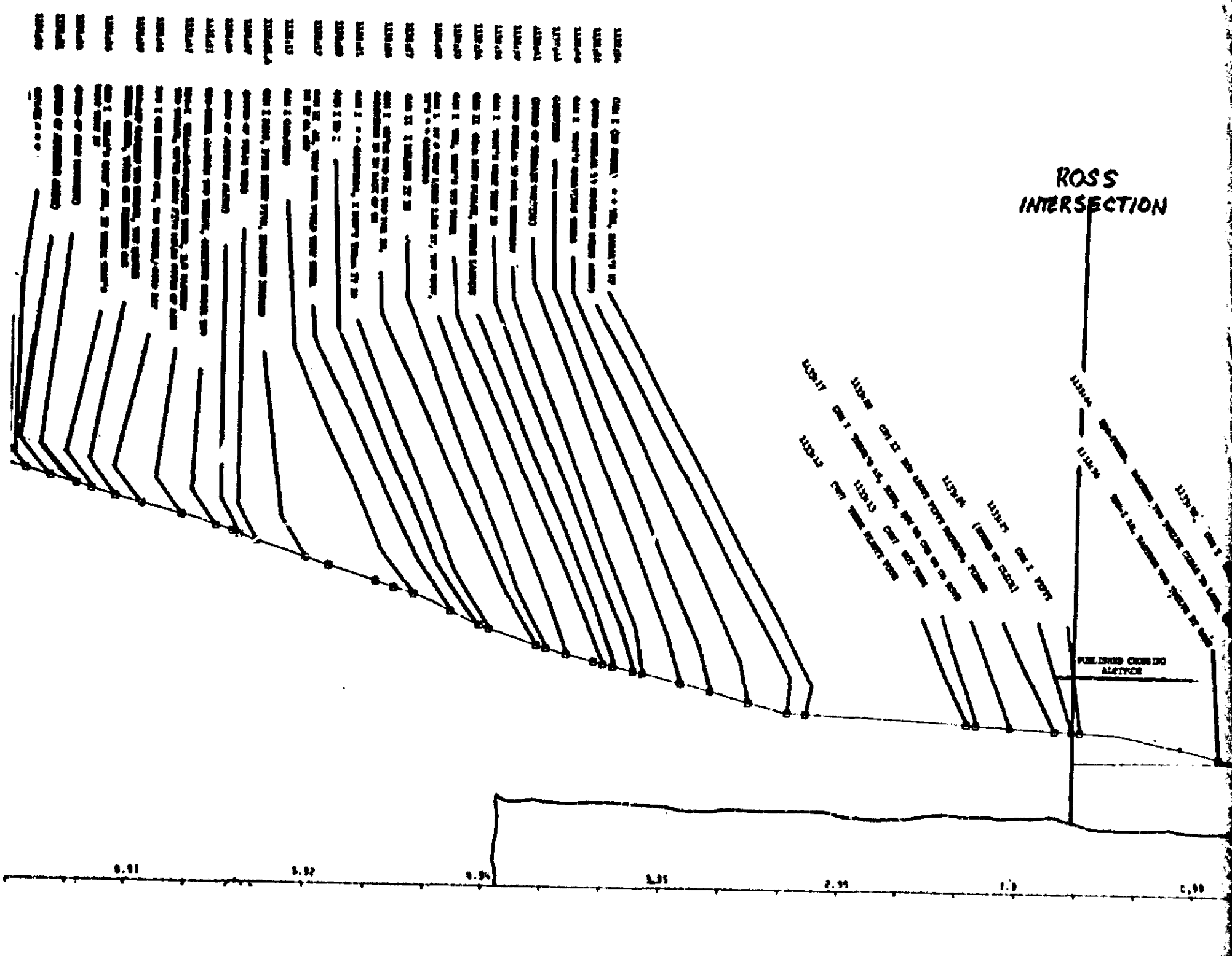
LEGEND

CAM=Cockpit Area Microphone
-1=Voice identified as Captain
1=Voice identified as First Officer
RDO=Radio
#=Nonpertinent word
*=Unintelligible word

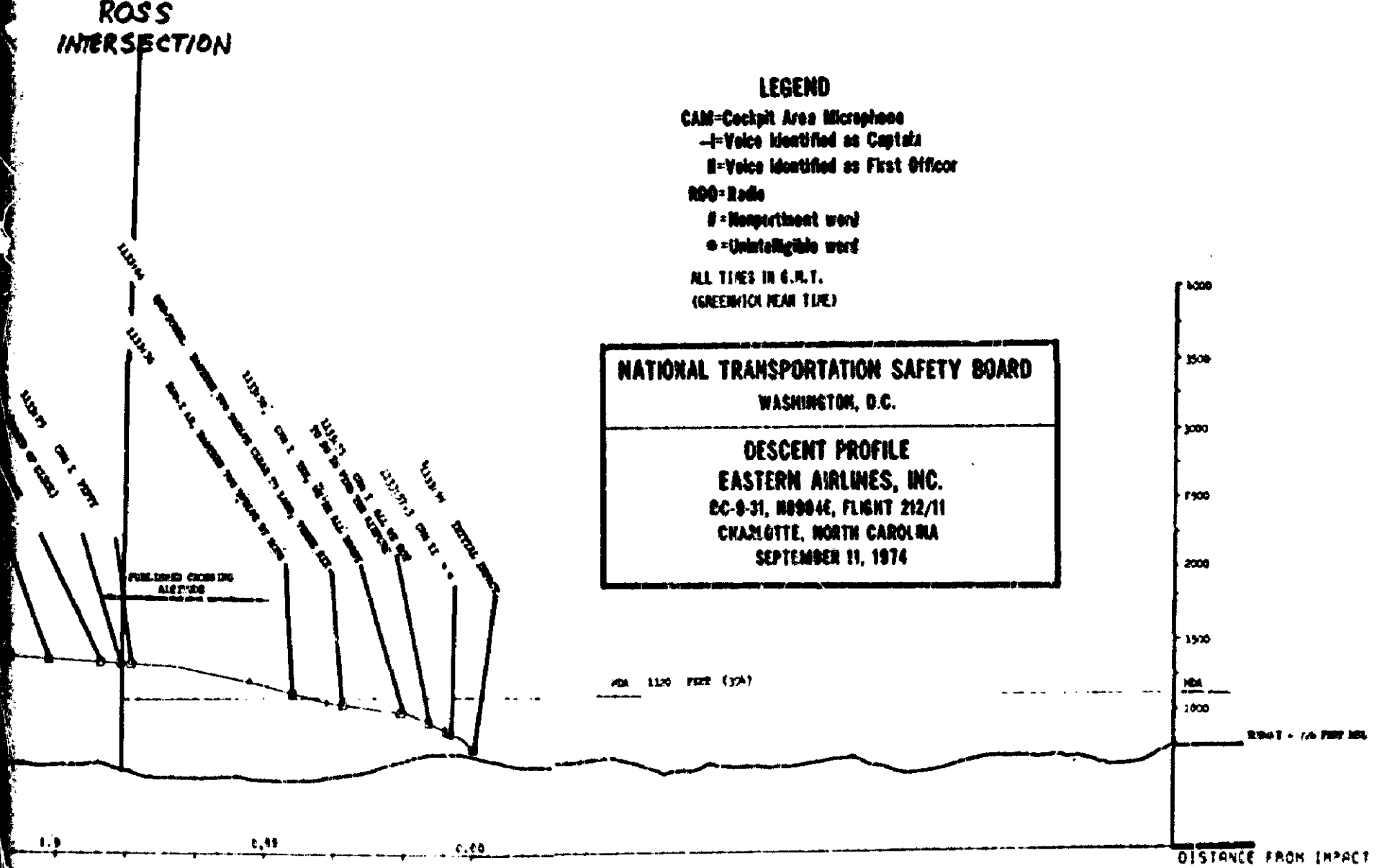
ALL TIMES ARE G.M.T.
(GREENWICH MEAN TIME)

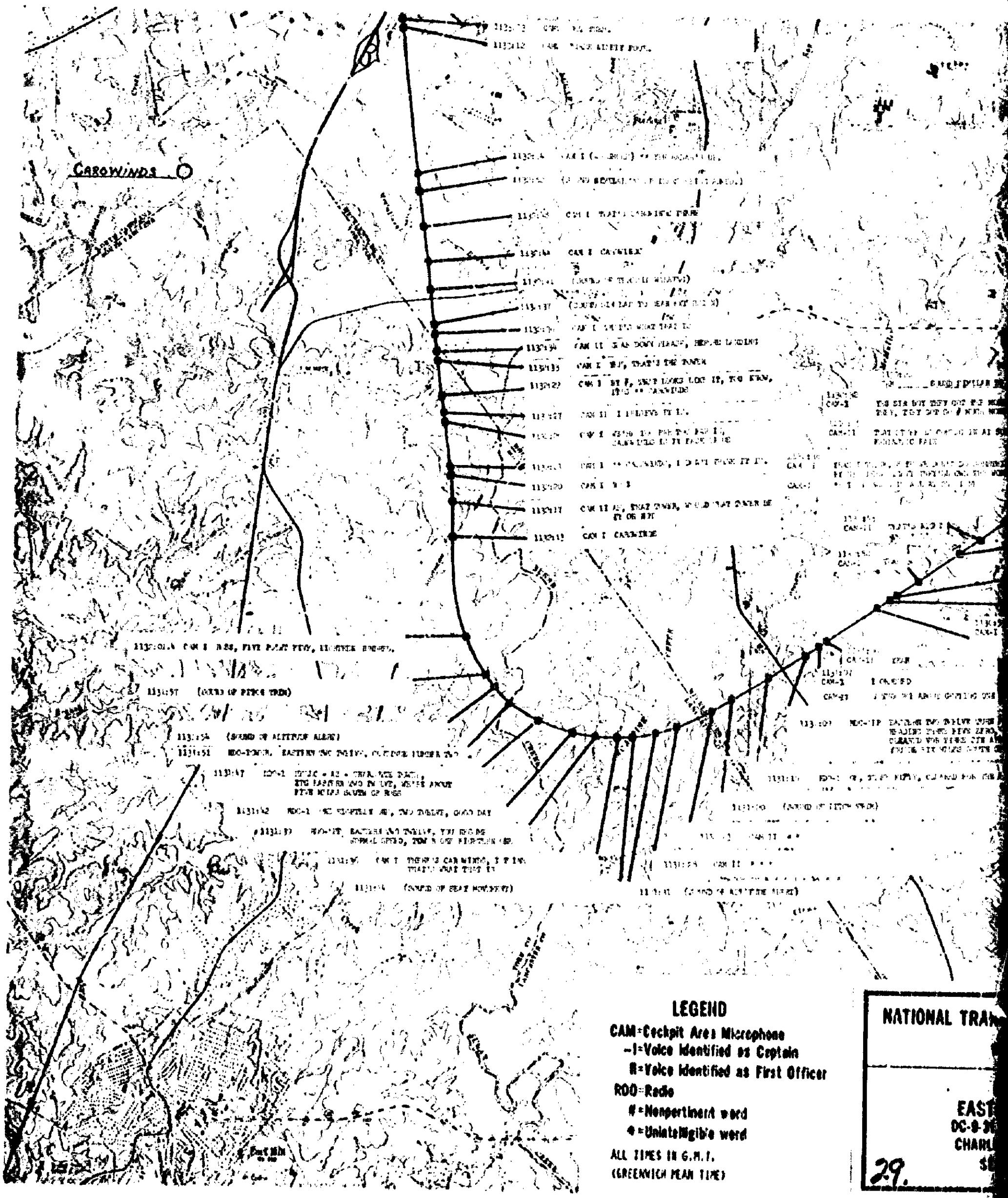
NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

DESCENT PROFILE
EASTERN AIRLINES, INC.
DC-9-31, N8984E, FLIGHT 212/11
CHARLOTTE, NORTH CAROLINA
SEPTEMBER 11, 1974


ROSS
INTERSECTION
PUBLISHED CROSSING
ALTITUDE

ROSS
INTERSECTION





LEGEND

CAM=Cockpit Area Microphone
- 1=Voice Identified as Captain
- 2=Voice Identified as First Officer

RDO=Radio
- #=Nonpertinent word
- *=Unintelligible word

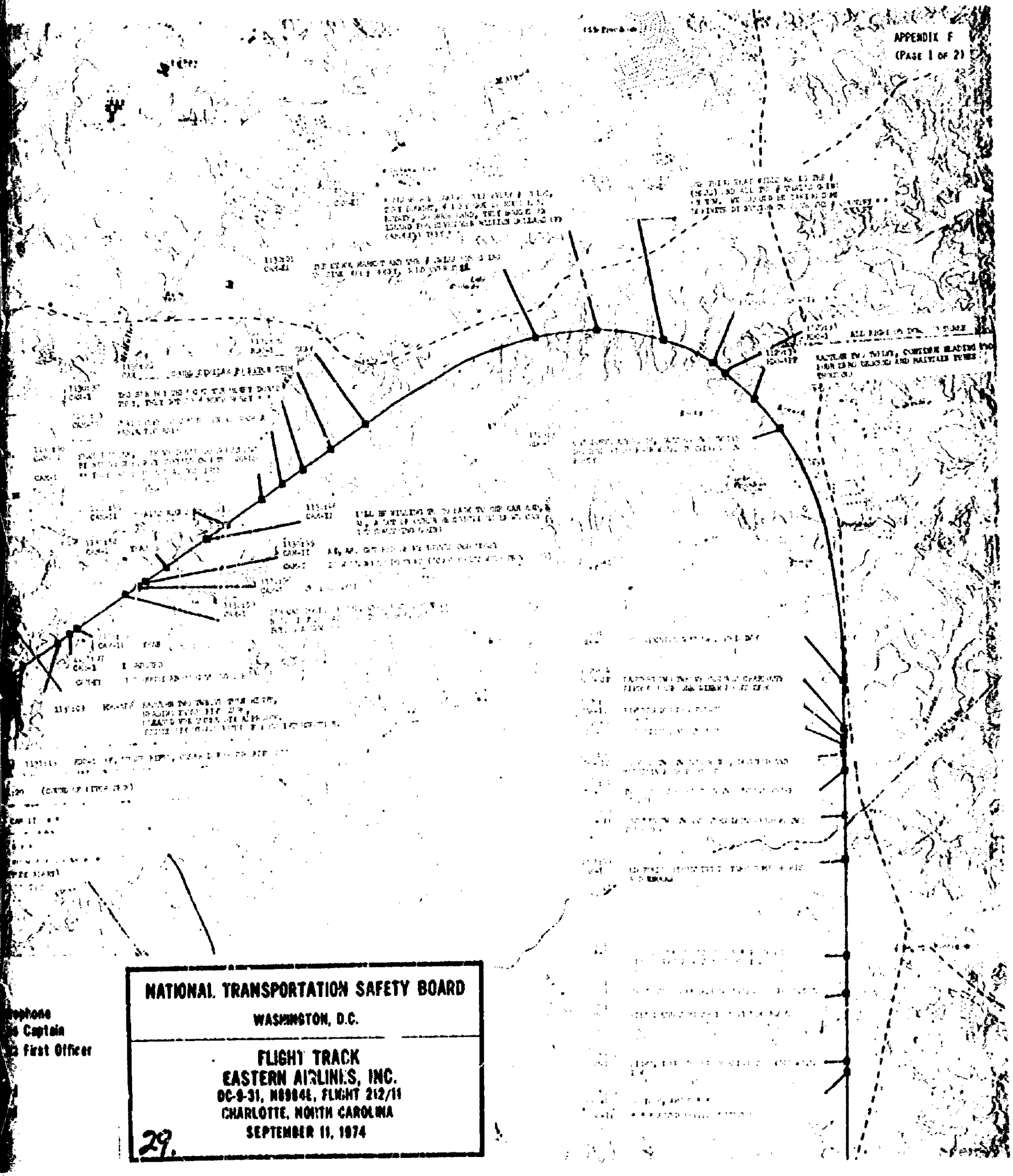
ALL TIMES IN G.M.T.
(GREENWICH MEAN TIME)

NATIONAL TRA...

EAST...
DC-9-3...
CHARL...
$...

29.

APPENDIX F
(PAGE 1 OF 2)

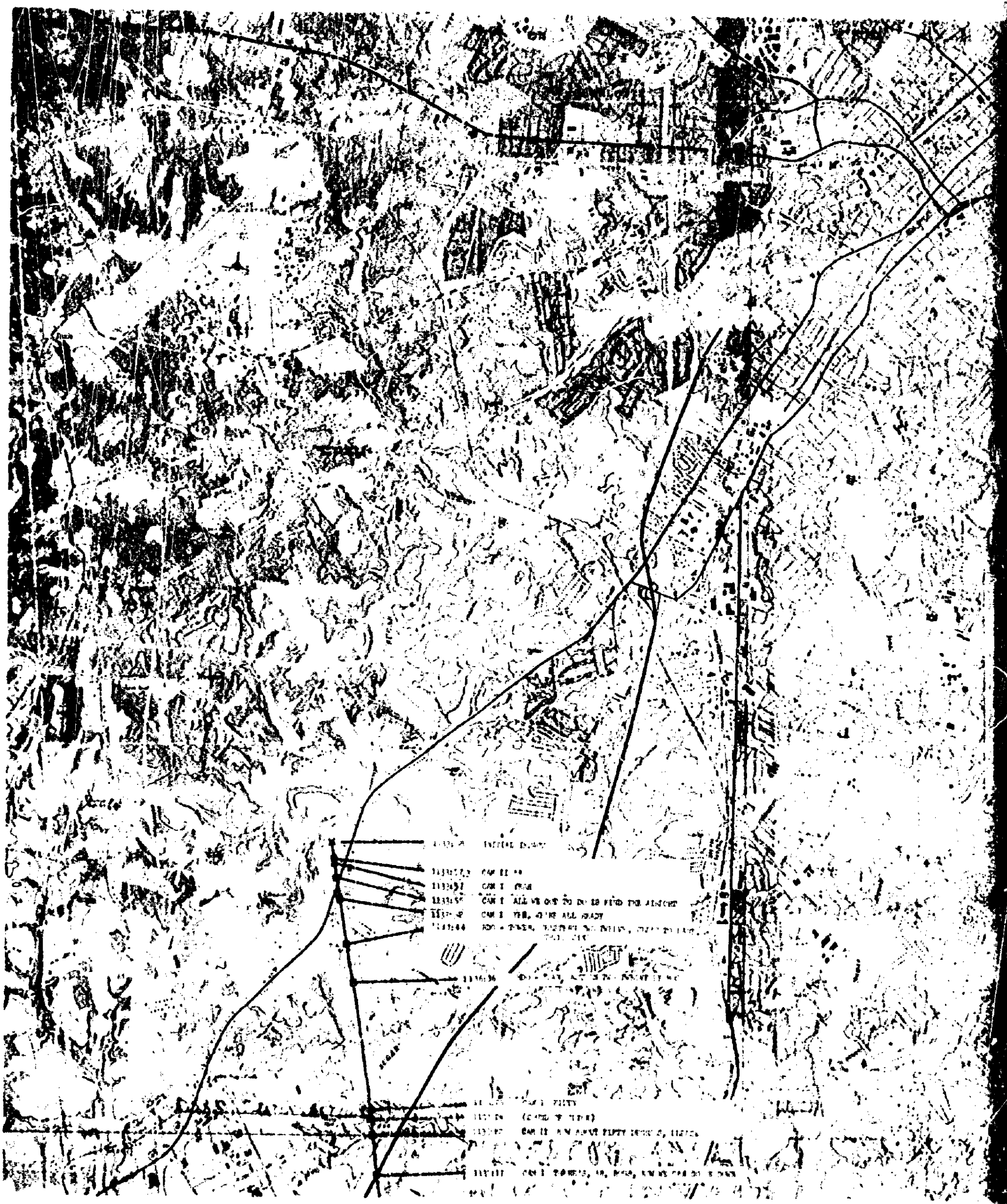


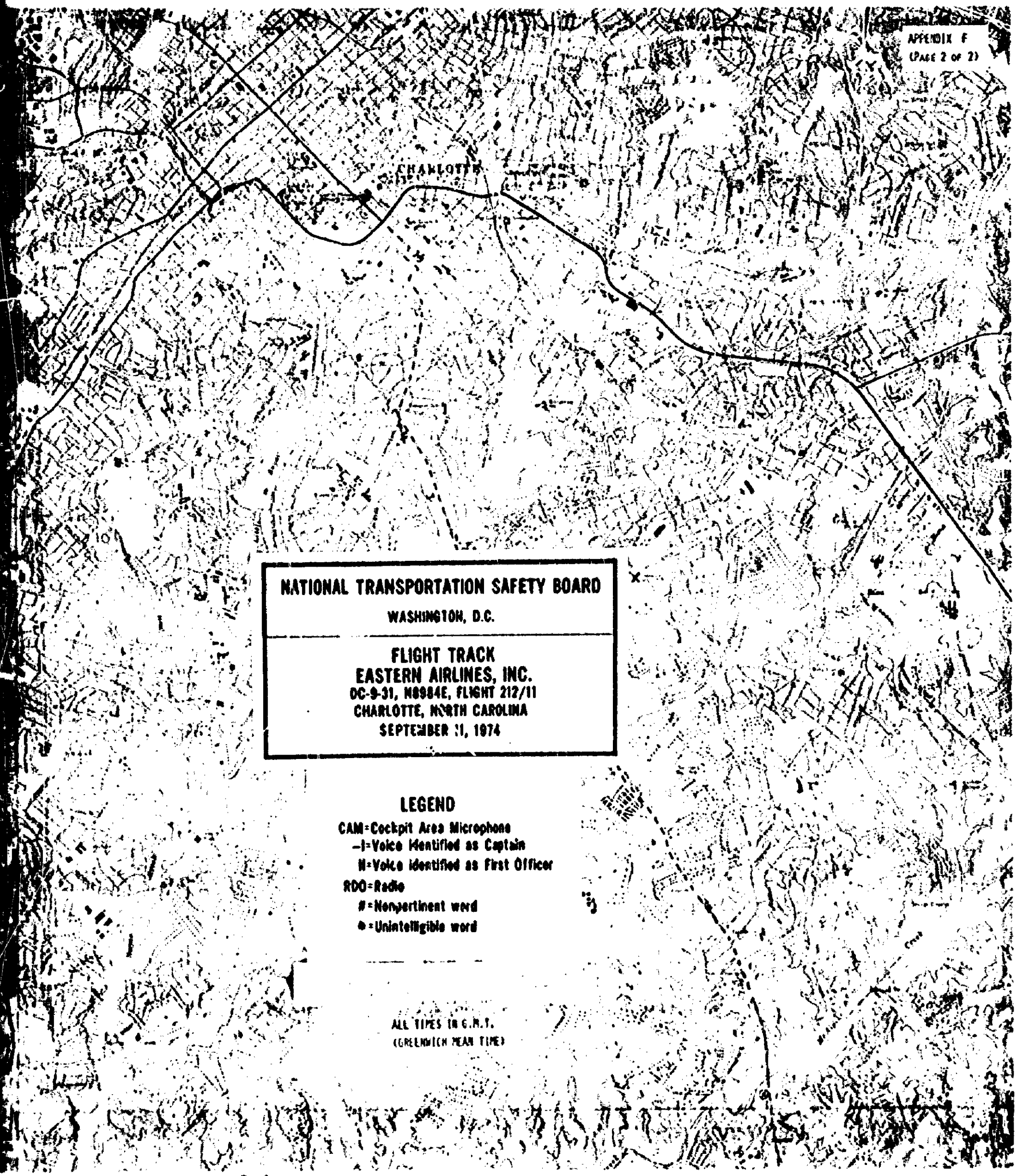
NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

FLIGHT TRACK
EASTERN AIRLINES, INC.
DC-9-31, N8984E, FLIGHT 212/11
CHARLOTTE, NORTH CAROLINA
SEPTEMBER 11, 1974

29.





NATIONAL TRANSPORTATION SAFETY BOARD

WASHINGTON, D.C.

FLIGHT TRACK
EASTERN AIRLINES, INC.
DC-9-31, N8984E, FLIGHT 212/11
CHARLOTTE, NORTH CAROLINA
SEPTEMBER 11, 1974

LEGEND

CAM=Cockpit Area Microphone
—1=Voice Identified as Captain
H=Voice Identified as First Officer
RDO=Radio
#=Nonpertinent word
●=Unintelligible word

ALL TIMES IN G.M.T.
(GREENWICH MEAN TIME)

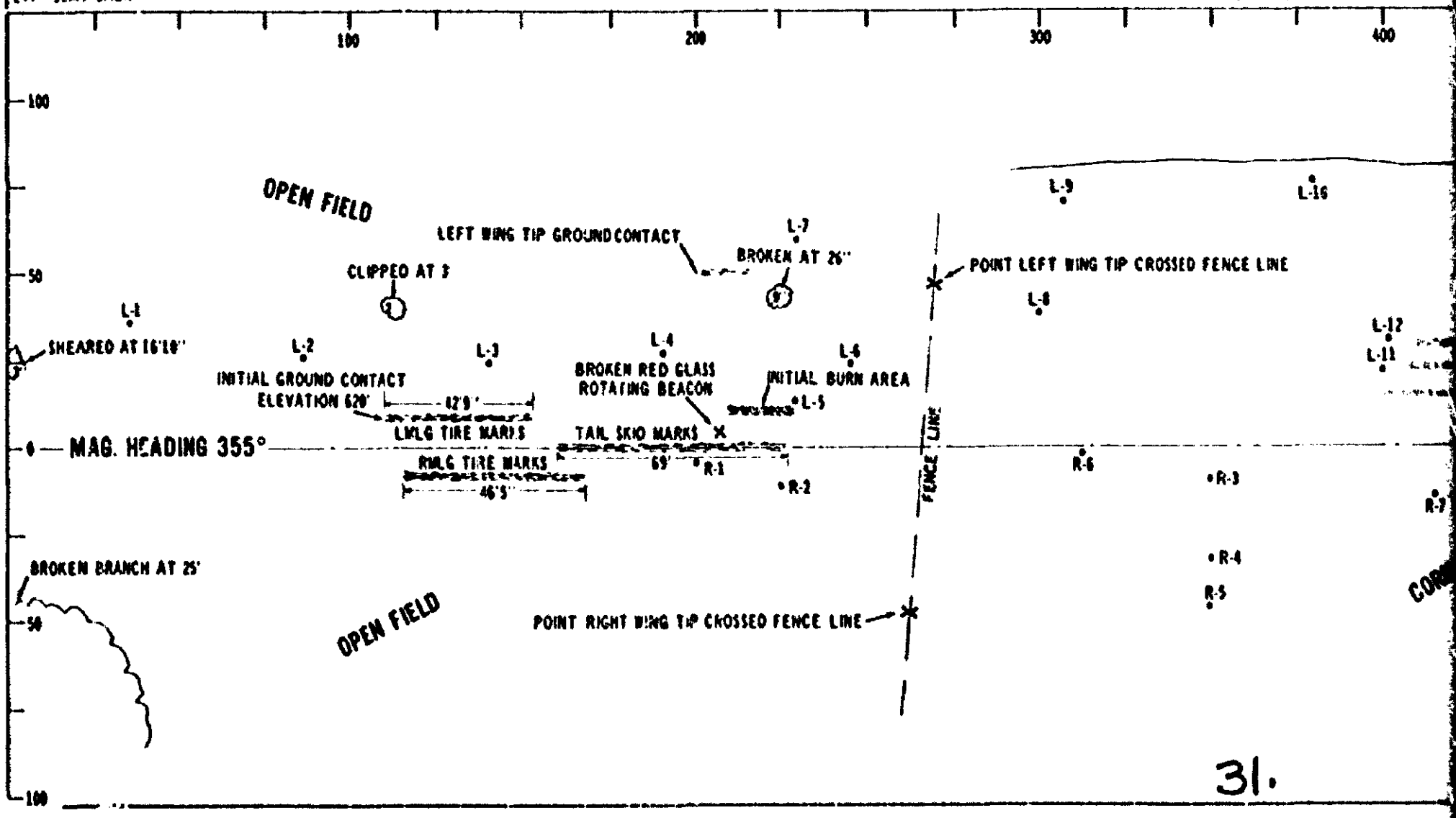
LEGEND

L. H. SIDE

L1 - 3"x 3" PIECE OF FIBERGLASS
L2 - 1½"x 1" PIECE OF AILERON TE
L3 - SMALL PIECE OF PANEL
L4 - 9" SECTION OF LINK ROD
L5 - FLAP ACTUATOR COVER
L6 - 2"x 1" PIECE OF ALUMINUM
L7 - SMALL PIECE OF ALUMINUM
L8 - LEFT WING OUTBOARD LE SLAT
L9 - LEFT WING TIP TE
L10 - LEFT WING TIP
L11 - FLAP VANE
L12 - LE SLAT
L13 - SLAT CONNECTOR SEAL
L14 - FLAP VANE
L15 - SECTION OF LEFT WING VENT
L16 - SECTION OF FLAP VANE
L17 - 3" SECTION OF SPOILER
L18 - NOSE GEAR ACTUATOR
L19 - MLG TRUNNION BOLT
L20 - MLG FLYING GEAR DOOR
L21 - NOSE GEAR SPRAY DEFLECTOR
L22 - SECTION OF AILERON WITH TAB
L23 - 2' SECTION OF FLAP
L24 - SECTION OF LEFT WING BOX SECTION
L25 - NOSE GEAR OLEO CHART
L26 - SECTION OF LEFT WING INBOARD SLAT
L27 - PIECE OF LEFT WING LE WITH WING SKIN AND SPAR WEB
L28 - SECTION OF STRUCTURE WITH SLAT TRACK AND ROLLER
L29 - 4'x 2' PIECE OF WING SKIN
L30 - 9'x 2' PIECE OF FUSELAGE SKIN
L31 - LEFT NOSE GEAR DOOR
L32 - 418 ASSEMBLY
L33 - MICROSWITCH
L34 - PIECE OF WHEEL WELL STRUCTURE
L35 - PANEL (9919358-401)
L36 - SPOILER PANEL WITH ACTUATOR
L37 - PANEL ASSEMBLY (5926003-7)
L38 - SECTION OF FLAP ASSEMBLY
L39 - SECTION OF FUSELAGE SKIN
L40 - ATTACHING STRUCTURE FOR LE SLAT TRACK
L41 - HYD. GROUND SERVICE ACCESS DOOR
L42 - 17'x 2' SECTION OF FUSELAGE SKIN
L43 - TRIM PANEL ASSEMBLY
L44 - SEAT BACK
L45 - LE SLAT
L46 - PANEL ASSEMBLY WITH LE SLAT MIXER
L47 - LE SEGMENT OF TE FLAP
L48 - ANTI-SKID VALVE, NUMEROUS PARTS OF WHEEL WELL
L49 - SECTION OF WING SKIN
L50 - SECTION OF LE SLAT
L51 - FLAP FAIRING ACTUATOR
L52 - 5910361-3 ASSEMBLY
L53 - BRACE ASSEMBLY
L54 - SECTION OF LEFT WING WITH FLAP ACTUATOR
L55 - SECTION OF FUSELAGE SKIN
L56 - 5'x 10' SECTION OF FUSELAGE SKIN WITH AIRFLOW SEPARATOR ATTACHED
L57 - 3'x 2' SECTION OF WING SKIN
L58 - SECTION OF NOSE WHEEL WELL STRUCTURE
L59 - 3'x 2' SECTION OF WING SKIN
L60 - LE SLAT TRACK AND SUPPORT STRUCTURE
L61 - FORWARD CARGO DOOR
L62 - SECTION OF FUSELAGE SKIN
L63 - COCKPIT AND PORTION OF PASSENGER CABIN
L64 - 8'x 6' INBOARD SECTION OF RIGHT WING WITH FLAP ACTUATOR ATTACHED
L65 - WING CENTER SECTION
L66 - NO. 2 ENGINE BULLET CONTAINING P-2 SENSOR
L67 - ENGINE NOSE COWL
L68 - RIGHT MAIN LANDING GEAR
L69 - NO. 2 ENGINE
L70 - AFT FUSELAGE SECTION WITH VERTICAL FIN, LEFT HORIZONTAL STABILIZER AND NO. 1 ENGINE

R. H. SIDE

R1 - 8"x 4" PIECE OF CABLE GUI
R2 - 6"x 6" PIECE OF FIBERGLASS
R3 - GROUND-AIR ACCESS PLATE
R4 - LE SLAT
R5 - 5910464-431 ASSEMBLY
R6 - FUEL PANEL ACCESS DOOR
R7 - ACCESS DOOR
R8 - PIECE OF SLAT
R9 - GEAR DOOR
R10 - SECTION OF LW UPPER SKIN
R11 - PIECE OF RIGHT WING TIP
R12 - RIGHT WING WITH FLAP AND
R13 - 3' SECTION OF RIGHT WING
R14 - HYDRAULIC ACCESS GEAR DO
R15 - RIGHT HORIZONTAL STABILI
R16 - 3' SECTION OF SPOILER FAIR
R17 - LE SLAT
R18 - MAIN GEAR HAND PUMP
R19 - SECTION OF WING SKIN
R20 - LE SLAT TRACK
R21 - SLAT SECTION
R22 - 9' SECTION OF RIGHT WING
R23 - REGULATOR AND ADAPTER
R24 - SPOILER AND ACTUATOR
R25 - SMALL SECTION OF MAIN SP
R26 - SPOILER PANEL SECTION
R27 - SECTION OF SLAT LE
R28 - FRONT SPAR FUEL CUTOFF VA
R29 - SECTION OF WING INBOARD
R30 - NOSE GEAR DOOR
R31 - FLAP VANE
R32 - INBOARD SECTION OF LE SL
R33 - RIGHT INBOARD SECTION OF
R34 - SECTION OF FRONT SPAR
R35 - VERTICAL FIN AFT TIP FAIRIN
R36 - SECTION OF LE SLAT WITH T
R37 - 4' SECTION OF WING SPAR
R38 - FUSELAGE FILLET FAIRING
R39 - FUSELAGE TAIL CONE
R40 - SECTION OF UPPER WING SK
R41 - LEFT MAIN LANDING GEAR
R42 - SECTION OF LOWER WING S
R43 - RIGHT WING FLAP SECTION
R44 - LE OF LEFT HORIZONTAL STA



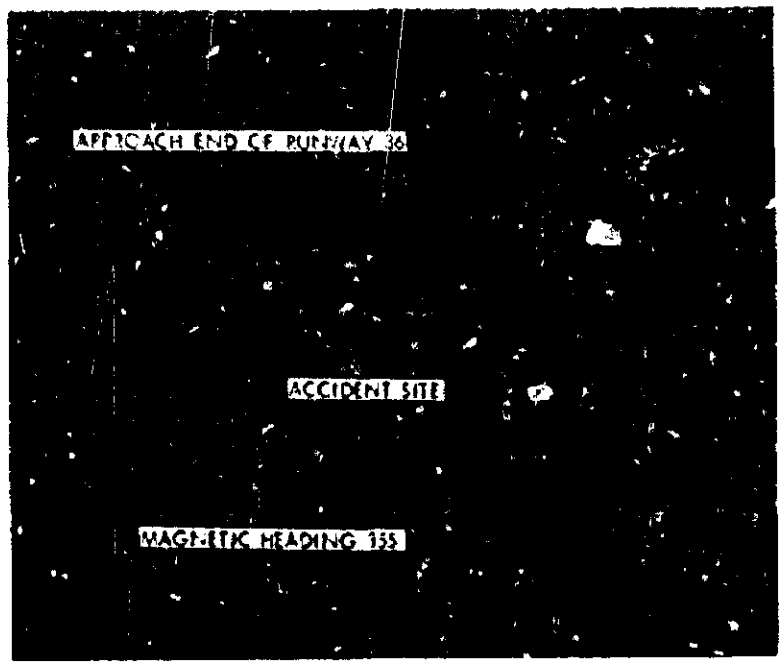
R. H. SIDE

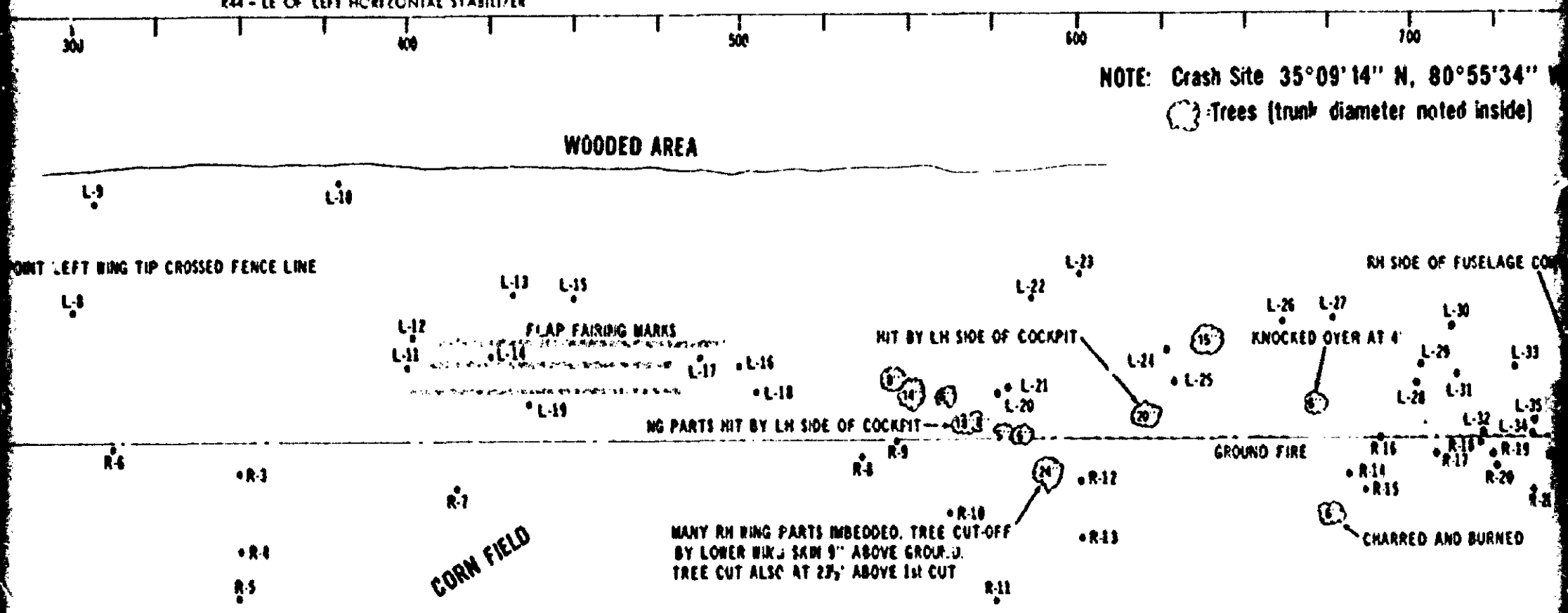
R1 - 8"x 4" PIECE OF CABLE GUIDE
R2 - 6"x 8" PIECE OF FIBERGLASS PACKING & RUBBER SEAL
R3 - GROUND-AIR ACCESS PLATE
R4 - LE SLAT
R5 - 5910464-431 ASSEMBLY
R6 - FUEL PANEL ACCESS DOOR
R7 - ACCESS DOOR
R8 - PIECE OF SLAT
R9 - GEAR DOOR
R10 - SECTION OF LW UPPER SKIN
R11 - PIECE OF RIGHT WING TIP
R12 - RIGHT WING WITH FLAP AND SPOILER
R13 - 3' SECTION OF RIGHT WING SLAT
R14 - HYDRAULIC ACCESS GEAR DOOR FAIRING
R15 - RIGHT HORIZONTAL STABILIZER WITH ELEVATOR
R16 - 3' SECTION OF SPOILER FAIRING HONEYCOMB
R17 - LE SLAT
R18 - MAIN GEAR HAND PUMP
R19 - SECTION OF WING SKIN
R20 - LE SLAT TRACK
R21 - SLAT SECTION
R22 - 9' SECTION OF RIGHT WING FLAP
R23 - REGULATOR AND ADAPTER
R24 - SPOILER AND ACTUATOR
R25 - SMALL SECTION OF MAIN SPAR
R26 - SPOILER PANEL SECTION
R27 - SECTION OF SLAT LE
R28 - FRONT SPAR FUEL CUTOFF VALVES & FILLER PANEL
R29 - SECTION OF WING INBOARD TE PANEL
R30 - NOSE GEAR DOOR
R31 - FLAP VANE
R32 - INBOARD SECTION OF LE SLAT
R33 - RIGHT INBOARD SECTION OF FLAP AND VANE
R34 - SECTION OF FRONT SPAR
R35 - VERTICAL FIN AFT TIP FAIRING
R36 - SECTION OF LE SLAT WITH TRACK ROLLERS
R37 - 4' SECTION OF WING SPAR
R38 - FUSELAGE FILLET FAIRING
R39 - FUSELAGE TAIL CONE
R40 - SECTION OF UPPER WING SKIN
R41 - LEFT MAIN LANDING GEAR
R42 - SECTION OF LOWER WING SKIN
R43 - RIGHT WING FLAP SECTION WITH VANE
R44 - LE OF LEFT HORIZONTAL STABILIZER

ATTACHED

ATOR ATTACHED

NTAL STABILIZER





NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

WRECKAGE DISTRIBUTION CHART
EASTERN AIRLINES, INC., DOUGLAS DC-9-31, N-8984E
3.3 STATUTE MILES SOUTH OF RUNWAY 36
DOUGLAS AIRPORT, CHARLOTTE, N.C.
SEPTEMBER 11, 1974

APPENDIX G

600 700 800 900

NOTE: Crash Site 35°09'14" N, 80°55'34" W

(trees) :Trees (trunk diameter noted inside)

100 50 0 50 100

BROKEN & KNOCKED OVER AT ROOT
KNOCKED OVER AT ROOT
RT SIDE OF FUSELAGE CONTACTED FS 463
LH WING CONTACT
KNOCKED OVER AT ROOT
KNOCKED OVER AT
OF COCKPIT
GROUND FIRE
CHARRED AND BURNED
OFF