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Aircraft Accident Report - Johnson and
Johnson, Inc., Grumman Gulfstream II,
N500J, Hot Springs, Virginia,
September 26, 1976

National Transportation Safety Board, Washington, D C

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16. Abstract <p>About 1038 e.d.t., on September 26, 1976, a Grumman Gulfstream II, N500J, owned and operated by Johnson and Johnson, Inc., crashed while making an instrument landing system approach (ILS) to the Ingalls Field Airport, Hot Springs, Virginia. The aircraft was destroyed by impact and fire. Three crewmembers and eight passengers were killed in the crash.</p> <p>While en route, the flight requested and received the Hot Springs weather which was indefinite ceiling--100 ft, sky obscured, visibility--1/8 mi in fog. About 1033, N500J was cleared for the ILS approach to runway 24 at Hot Springs. At 1036, N500J reported out of 5,000 feet which was the last known transmission from the aircraft.</p> <p>The accident site was located about 750 feet from the threshold of runway 24 and about 500 feet below the runway touchdown zone elevation of 3,766 feet.</p> <p>The National Transportation Safety Board could not determine the probable cause of the aircraft's descent below decision height and impact with terrain 500 feet below the elevation of the runway.</p>			
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NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C. 20594

AIRCRAFT ACCIDENT REPORT

Adopted: February 9, 1978

JOHNSON & JOHNSON, INC.
GRUMMAN GULFSTREAM II, N500J
HOT SPRINGS, VIRGINIA
SEPTEMBER 26, 1976

SYNOPSIS

About 1038 e.d.t. on September 26, 1976, a Grumman Gulfstream II, (G-1159), N500J, owned and operated by Johnson & Johnson, Inc., crashed while making an instrument landing system (ILS) approach to the Ingalls Field Airport, Hot Springs, Virginia. The aircraft was destroyed by impact and fire. Three crewmembers and eight passengers were killed in the crash.

While en route, the flight had requested and received the Hot Springs weather which was indefinite ceiling--100 feet, sky obscured, visibility--1/8 mile in fog. About 1033, N500J was cleared for the ILS approach to runway 24 at Hot Springs. At 1036, N500J reported out of 5,000 feet, which was the last known transmission from the aircraft.

The accident site was located about 750 feet from the threshold of runway 24 and about 500 feet below the runway touchdown zone elevation of 3,766 feet.

The National Transportation Safety Board could not determine the probable cause of the aircraft's descent below decision height and impact with terrain 500 feet below the elevation of the runway.

1. FACTUAL INFORMATION

1.1 History of the Flight

On September 26, 1976, Johnson & Johnson, Inc.'s, Grumman Gulfstream II (N500J) was scheduled to transport company executives from Mercer County Airport, Trenton, New Jersey, to Ingalls Field Airport, Hot Springs, Virginia. The flightcrew arrived at the airport at 0800. ^{1/} The copilot and crew chief conducted a preflight inspection of the aircraft, and the captain prepared the flight plan. At 0915, the captain was briefed by a meteorologist of the National Weather Corporation, which provided meteorological services for Johnson & Johnson. At that time, the Ingalls Field forecast for the flight's estimated time of arrival was: Ceiling--1,000 ft broken, 3,000 ft overcast, visibility--2 mi with fog, wind--160° at 8 kns, temporarily 500 ft overcast, visibility--1 mi with light rain showers and fog. Lowering conditions were possible toward early afternoon. The meteorologist stated that the captain was concerned by the Hot Springs forecast and that the captain had mentioned Roanoke, Virginia, and Lewisburg, West Virginia, as good alternates. He then filed two IFR flight plans with the North Philadelphia Flight Service Station (FSS)--one from Trenton to Hot Springs and one for the return flight.

At 0944, the flight departed Mercer County Airport and climbed to flight level (FL) 310. At 1017:51, the flight was cleared direct to Montebello VOR, about 35 mi east of Hot Springs. Shortly thereafter, the crew requested the current Hot Springs weather on 122.0 MHz from Raleigh FSS and both the Washington, D.C., FSS and Charleston, West Virginia, FSS responded with the current weather--indefinite ceiling 100 ft, sky obscured visibility--1/8 mi in fog, temperature 56° F, dewpoint 56° F, wind 160° at 8 kns.

At 1021:10, N500J was cleared by the Gordonsville low sector radar controller of the Washington Air Route Traffic Control Center (ARTCC) to descend at the pilot's discretion from FL 310 to FL 260. Four minutes later the crew was given a vector of 270° and was cleared to 11,000 ft. ^{2/} The Charlottesville, Virginia, altimeter was given as 30.07 in. Subsequently, the flight was given the Hot Springs altimeter of 30.11 and was cleared to continue descent to, and maintain, 6,000 ft. At 1025:28 air traffic control of the flight was changed to the Hot Springs low sector of the Washington ARTCC. At 1031:28, communications were established with the Hot Springs low sector controller when the flight reported out of 11,000 ft descending to 6,000 ft. Seconds later another aircraft, N8300E (a Beech King Air 100), reported executing a missed approach and N500J asked the controller if that was at Hot Springs. The controller responded "affirmative" and N500J acknowledged. At 1033:04, N500J was told, "...and five hundred Jay, cleared for the ILS approach into Hot Springs, report out of five."

^{1/} All times herein are eastern daylight, based on the 24-hour clock.

^{2/} All altitudes herein are mean sea level, unless otherwise indicated.

About 1033:32, the flight passed Armstrong Intersection (on the localizer course 12.6 nmi northeast of the threshold of runway 24 at Hot Springs). Shortly thereafter, the controller advised that N500J was intercepting the localizer. At 1036:42, N500J reported "out of five." This was the last known transmission from the aircraft.

The airport manager stated there were no communications with N500J. He was first alerted to the possibility of a crash at 1044 when the Roanoke FSS inquired if he knew where the plane was. About 1100, two employees were sent to the east side of the field where they reported the smell of smoke and burning rubber. According to the airport manager, the ceiling and visibility were zero. A search party was organized about 1230 and the wreckage was located at 1425.

The aircraft crashed at 37° 57' north latitude and 79° 50' west longitude at an elevation of 3,220 ft during daylight hours.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	3	8	0
Serious	0	0	0
Minor/None	0	0	0

1.3 Damage to Aircraft

The aircraft was destroyed by impact and fire.

1.4 Other Damage

Ground fire consumed numerous trees and underbrush at the crash site.

1.5 Personnel Information

The captain, first officer, and crew chief were trained and certificated according to current regulations. (See Appendix B.) The captain had flown into Hot Springs on April 4, 1968, on October 4 and 8, 1972, and on May 2, 1973. The first officer had flown into Hot Springs on August 7, 1971, and on May 6, 1973.

All three crewmembers had been off duty for more than 24 hours before the flight.

The Hot Springs low sector radar and handoff controllers became full performance air traffic controllers with Federal Aviation Administration (FAA) in 1970. The manual controller became a full performance controller in March 1974. (See Appendix B.)

1.6 Aircraft Information

N500J was certificated, maintained, and equipped according to FAA regulations. (See Appendix C.) The aircraft's gross weight and center of gravity at the time of the accident were 51,000 lbs and 32 percent mean aerodynamic cord, respectively; both were within specified limits.

Before the flight left Trenton, the aircraft had been fueled with 7,537 lbs of jet-A fuel; 18,000 lbs were on board at departure and 13,500 lbs were on board when the aircraft crashed.

In addition to two VHF transceivers and two ADF receivers, the aircraft was equipped with dual Sperry SPI-73E integrated instrument systems; a Litton LTN-51 inertial navigation system (INS), a Bendix doppler DRA-12/CPA-24 navigation system, a Sperry SP-50G autopilot, a United Control, Inc., approach speed control system with an angle of attack headup display system, dual Mode C type transponders, one International Dynamics Corp. (IDC) enclosing altimeter (pilot), one IDC pneumatic servo type altimeter (copilot), and a Collins 339H-1 (0-2500) radio altimeter. The angle of attack, headup display aids the pilot in rapidly acquiring and maintaining the recommended reference speed for the approach. Speed deviation is displayed on the fast/slow indicator of the flight director and the approach indexer, which consists of three lights. All components were reported to be operational when the flight departed Trenton.

1.7 Meteorological Information

The area forecast, issued by the National Weather Service (NWS) forecast office at Washington, D.C., at 2040 on September 25, 1976, and valid for the time of the accident, indicated that the eastern portion of a cold front which extended from the St. Lawrence Valley to southern Wisconsin, would move southward and extend from northern Virginia to a developing low in southern Wisconsin by 1500 on September 26. The significant clouds and weather included ceilings from 1,500 to 3,00 ft broken to overcast, and showers and thunderstorms which would reduce ceilings and visibilities to 1,000 ft and 3 mi or less; ridges would become obscured frequently.

The area forecast showed a freezing level slope of 10,000 ft in Ohio, Maryland, Delaware, West Virginia, and Virginia, to 11,000 ft-- 13,000 ft in North Carolina and South Carolina. Locally, light to moderate rime icing in clouds would develop in Ohio and spread eastward and southward. The Dulles International Airport 0800 radiosonde sounding showed intermittent layers of stable and conditionally unstable moist air and the freezing level at 10,500 ft.

The surface weather observations for September 26 made by the Supplementary Aviation Weather Reporting Station (SAWRS) at Hot Springs were, in part, as follows:

- 0800 - Partial obscuration, 300 ft red ceiling estimated 800 ft broken, 1,500 ft overcast, visibility--4 mi, fog, temperature--57° F, dewpoint--55° F, wind--230° at 12 kns, altimeter setting--30.11 in, visibility--south 1 mi.
- 0900 - Ceiling indefinite, 300 ft obscuration, visibility 1 mi, fog, temperature--57° F, dewpoint--55° F, wind--180° at 12 kns, altimeter setting--30.12 in.
- 1000 - Ceiling indefinite, 100 ft obscuration, visibility--1/8 mi, fog, temperature--56° F, dewpoint--56° F, wind--160° at 8 kns, altimeter setting--30.11 in.
- 1100 - Ceiling indefinite zero, visibility--zero, fog, temperature--56° F, dewpoint--56° F, wind--180° at 13 kns, altimeter setting--30.10 in.

These observations were logged as record specials; "record" denoting that they were taken on the hour and "special" denoting that there was a significant change in the weather since the previous report. The observer is not required to make additional special observations once the weather has deteriorated below landing minimums.

According to Washington ARTCC personnel, the 1000 hourly weather sequence report was automatically entered into the computer and was available at all sector controllers' locations.

The Dulles International Airport, Va., and Huntington, W. Va., 0800 winds aloft observations for the heights indicated were as follows:

<u>Height</u> (ft m.s.l.)	<u>Dulles</u>		<u>Huntington</u>	
	<u>Direction</u> (°true)	<u>Speed</u> (kn)	<u>Direction</u> (°true)	<u>Speed</u> (kn)
6,000	235	21	220	20
7,000	235	23	225	19
8,000	235	24	225	19
9,000	240	22	225	18
10,000	-	-	225	17
12,000	240	26	225	23

1.8 Aids to Navigation

Runway 24 at Hot Springs is served by a nondirectional beacon approach procedure and an ILS approach procedure. The runway 24 ILS consists of an outer marker compass locator (LOM), which is 3.7 nmi from the runway threshold, a localizer, and a glide slope. No middle marker (MM) or approach lights are installed. The minimum altitude at the LOM is 5,000 ft and the glide slope is intercepted at 4,997 ft. The LOM is located on terrain which is about 1,800 ft below airport elevation and the final approach course is 243°. The commissioned width of the localizer is 5°. The glide slope centerline angle is 3° + .73°. The glide slope is 59 ft above the runway threshold. When all components of the ILS are operating and the Hot Springs altimeter setting is being used, the ILS approach procedure minimums are 3/4 mi visibility and a decision height (DH) of 4,066 ft--300 ft above the runway touchdown zone (TDZ). (See Appendixes D and F.)

The components of the ILS are monitored electronically in the airport manager's office at the Ingalls Field Airport terminal building. The monitors guard the glide slope, the localizer, and the LOM; each provides a visual and an aural alert if a component malfunctions. If a component causes an alarm, the component automatically shuts down and its status is reported by the employee on duty in the airport manager's office. Airport personnel and an FAA facilities technician stated that no alarms sounded on the day of the accident.

The approach chart for the Hot Springs ILS runway 24 contains the following:

"CAUTION: Precipitous terrain underlying this procedure.
Turbulence of varying intensities may be encountered."

On September 28, 1976, the ILS system was flight inspected and was found to operate within prescribed parameters. The pilots of three aircraft that had made missed approaches from runway 24 at 0920, at 1034, and at 1130 reported that the ILS functioned properly. They reported later that their missed approaches were executed at minimums when they did not have visual contact with the runway.

1.9 Communications

There were no reported problems in communications with Hot Springs (Ingalls Field) when N^c00J operated in the area. Seventeen radio contacts were made between 0912 and 1202, six of which were between 1030 and 1053. The aircraft and radio log for September 26 showed that no aircraft had landed at Hot Springs. The transcript of ATC communications disclosed that from 1017 to 1032, three aircraft executed missed approaches

and diverted to other airports. At 10:37:45, 5 minutes after N500J was cleared for the ILS approach, a Cessna Citation on a vector to the localizer diverted to Lewiston, Virginia, because of weather.

The Hot Springs low sector is formed only during periods of heavy traffic when conventions are held at Hot Springs and at Lewisburg. From 1031:28, when N500J first contacted the controller, until 1039:55, when the controller asked for the aircraft's identification and altitude, there were 117 pilot/controller communications. Sixty-three were made by the pilots of 17 aircraft and 54 by the controller. On the average, there was a communication every 4.3 seconds.

1.10 Aerodrome Information

Ingalls Field, elevation 3,792 ft, is owned by the Allegheny, Bath, Clifton Forge, Covington Airport Committee and is operated by Virginia Hot Springs, Inc. It is an uncontrolled airport certificated for air carrier operations under 14 CFR 139; there were no exemptions in effect on the day of the accident.

Runway 6/24, the primary runway, is 5,602 ft long and 100 ft wide. It is surfaced with a hard bituminous concrete, which has an antiskid "popcorn-type" finish. The runway has medium intensity runway lights (MIRL) at 200-ft intervals with standard green threshold lights. The last 2,000 ft of runway 24 has amber lights. The MIRL's have three settings--10 percent, 30 percent, and 100 percent; they were set at 100 percent at the time of the accident. Runway 24 has runway end identifier lights (REILS) and a VASI, both of which were on at the time of the accident. The rotating beacon, located 750 ft south of runway 6/24, was on at the time of the accident.

1.11 Flight Recorders

A reel-to-reel type tape recorder capable of recording only VHF communications was installed in N500J by the company. It was destroyed in the accident. No cockpit voice recorder or flight data recorder was required to be installed.

1.12 Wreckage and Impact Information

The aircraft first struck trees at an elevation of 3,275 ft on the face of a steep, heavily wooded slope, and cut a level swath, 80 ft wide and 125 ft long, oriented on a magnetic bearing of 243°. The plane first hit the ground at an elevation of 3,266 ft, 750 ft short of the threshold of runway 24 and 500 ft below the runway TDZ. After impact with a rock outcropping, the wreckage continued along a bearing of 245° and was scattered up the mountain slope about 305 ft. The swath through the trees was at a 5° descent angle. This closely approximates the 6° glidepath determined from the last two radar track positions. The attitude of the aircraft could not be determined. (See Appendix F.)

The aircraft was destroyed by impact and severe ground fire. The wreckage parts outside the 140- by 300- ft burned area were unburned except for a cabin seat, a food container, a 20- by 20-in. piece of soundproofing, and the left main landing gear's fixed door and outboard tire and wheel rim. However, a ground explosion was evidenced by molten aluminum spattered into trees on the right side of the wreckage path. A piece of sun visor was wrapped around a small tree trunk outside the burned area. Most of the aircraft's structure was melted. Portions of the left and right wing flap structure located near the initial tree impact site, showed no signs of damage due to fire or smoke. Pieces of the right main landing gear found embedded in the rock outcropping were not damaged by fire or smoke.

The bulb filaments from the rotating beacon on top of the fuselage, the empennage navigation light, and the left wingtip navigation light were elongated. The right wingtip navigation light was destroyed.

Although the cockpit destruction virtually precluded documentation of cockpit settings and controls, the following data were obtained from the wreckage:

<u>Instrument</u>	<u>Status</u>
o Autopilot panel	Lever disengaged
o Flight director	15° climb, 10° right turn
o Cabin altimeter	3,200 ft, 0.4 p.s.i. differential
o Copilot's radio altimeter	Bug at 300 ft, indicator at 50 ft
o Altitude preselect controller	Set at 5,000 ft. barometric setting at 30.--. Switch between "auto" and "off."
o Pitot static defect corrector panel	Static valve--open and safety wired pitot valve--near full "off"
o Pitot static shutoff valves to air data computer	Both separated and burned in "open" position

The landing gear was down and locked at impact and the flaps were extended 20°. The horizontal stabilizer, which is geared to the flap position, was trimmed for the 20° flap position. The rudder and right elevator trim tab actuators were intact and in the neutral position, but were free to move. The left aileron trim mechanism, when compared with another aircraft, indicated 6° left roll. The aileron actuators were in the left wing down position, but the piston extension exceeded the normal hydraulic travel.

The right wing flight spoilers were attached to a section of wing structure and both panels were down. The flight spoiler actuator was in place and extended (down position). The right wing ground spoiler was separated from the wing, but the actuator was attached to the wing structure and was down and locked.

The left wing flight and ground spoilers were separated from the wing structure. The left flight spoiler actuator was recovered in three pieces, but it was extended (spoilers down). The left ground spoiler actuator was separated from the wing structure by impact forces and was unlocked and fully extended. The flight and ground spoiler panels were crushed rearward along the leading edges.

One inverter was recovered and the rotating mass exhibited rotational scoring. None of the three aircraft batteries showed evidence of overheating internally and each retained sufficient charge to arc when tested.

Both engine fire extinguisher containers were separated from their mounts and were damaged by impact and fire. There was a convex dent directly opposite the two discharge cartridges, and both frangible discs in each container were broken.

Both engines had separated from the aircraft structure, but were located within the main wreckage ground fire area. They had been damaged by severe impact and fire. The No. 1 engine (left) fixed cowling and pylon structure were still attached, and the compressor blades were bent opposite the direction of rotation. The thrust reverser assembly was detached and recovered downslope. The assembly had been damaged severely by impact, but had not been burned. The actuator was in the stowed position.

The No. 2 engine (right) was upslope from the No. 1 engine and the fixed cowling and parts of the pylon structure were attached. The compressor blades were bent opposite the direction of rotation. About 75 percent of the low-pressure compressor vanes and 65 percent of the intermediate casing had been consumed by fire. The thrust reverser assembly separated and had been damaged severely by impact and fire. The actuator was in the stowed position.

1.13 Medical and Pathological Information

Autopsies were performed on the three crewmembers and there was no indication of any pre-existing disease which would have affected the performance of their duties. Toxicological examinations for alcohol, carbon monoxide, and barbituates were negative for all crewmembers. Similarly, the autopsies and toxicological tests on the passengers revealed no significant findings.

1.14 Fire

An intense ground fire melted most of the aircraft structure and burned trees and underbrush in the wreckage swath. Firefighting equipment could not reach the area because of the precipitous terrain.

1.15 Survival Aspects

This accident was not survivable because of the high decelerative forces and the destruction of the occupiable area of the aircraft.

1.16 Tests and Research

Both aircraft engines were disassembled by Airwork, Inc., a Rolls Royce-approved overhaul facility. The Board's powerplant group examined the internal components but found no evidence of preimpact failure or malfunction of either engine. However, the outboard high-pressure (HP) pneumatic system tapping pipe (P/N 3714) of the No. 2 engine was found disengaged from the nut (P/N EU12069) within the HP diffuser case. A sleeve and spacer ring remained misaligned within the pipe assembly. The threads of the tapping pipe contained a silver protective coating, which was not found on threads that had been damaged.

After examining these parts from the No. 2 engine of N500J Rolls Royce concluded: "...that the parts were in the correctly assembled position up to the time of the aircraft crash and that during the impact sequence some externally applied load forced the tube out of the connector at an angle."

At the request of Rolls Royce, an independent test was conducted by Cooper Airmotive, Inc., an approved overhaul facility, to determine what effect the separated HP tapping pipe would have on engine operation. After operating an uncowed engine for 10 minutes, 4 1/2 minutes of which were above idle power, an irregularly shaped hole, about 12 ins. square, ruptured in the bypass duct. The sleeve and spacer ring were dislodged from the pipe assembly; no hole was found in the No. 2 engine of N500J.

The test also showed that with the tapping pipe separated, but as close to the diffuser case nut as possible, and at full throttle N_1 was 83 percent and N_2 was 91 percent. At a 70 percent N_2 setting, to simulate approach power setting conditions, N_1 read 38 percent--a difference of 32 percent. Under standard atmospheric conditions, N_1 would normally indicate 36 to 40 percent.

The aircraft was equipped with two pairs of flight spoilers (outboard) and one pair of ground spoilers (inboard). According to the flight manual, the flight spoilers operate in conjunction with the ailerons and provide the principal means of lateral control. They can also be extended symmetrically to serve as speed brakes. The ground spoilers provide aerodynamic braking upon aircraft touchdown. When armed, the ground spoilers extend (55°) and through mechanical linkage, trigger the flight spoilers to extend (55°). The ground spoiler hydraulic system consists of a solenoid-operated primary control valve, a flow divider, and two actuating cylinders. The flow divider insures a balance of pressure between the two actuating cylinders for symmetrical operation. The cylinders include integral "ball locks" which keep the actuators mechanically locked in the stowed position. Only hydraulic pressure can open these locks. The ground spoiler electrical circuit receives power from the main direct current (DC) bus. The solenoid control valve is energized when the following conditions are met: (1) Power must be on the main DC bus, (2) weight of the aircraft must be on the main landing gear, (3) ground spoiler switch must be in the armed position, and (4) both throttles must be at ground idle. A red rectangular light in about the center of the glareshield is placarded "No Ground Spoilers." Anytime the throttles are retarded and the ground spoilers are stowed, the warning light will be illuminated.

N500J was also equipped with a ground spoiler deactivate system which would release hydraulic pressure when a handle in the cockpit is pulled in the event of in-flight ground spoiler deployment.

Under supervision of the Safety Board, both ground spoiler actuators were examined and a metallurgical analysis was conducted at the Grumman American facility at Savannah, Ga. The following conclusions were drawn:

The ground spoiler primary control valve was X-rayed and it disclosed that the solenoid valve and pilot valve were securely centered. This shows that the actuators were not pressurized to extend. The flow divider was also X-rayed and it showed that the piston was secure within 1/32" of being in the centered position, which would have provided a balance of pressure to both actuators.

The ground spoiler deactivate valve was subjected to impact force and fire. Examination revealed it had rotated approximately 60° towards the open position. However, there was no evidence that the assembly had moved to the full deactivate position.

All six "ball locks" of the left ground spoiler actuator were distorted by impact forces.

During impact, both left hand and right hand piston terminals fractured in bending through the 7/16-20NF-3A threads. The terminals failed in an inboard direction while both ground spoiler actuators were locked in the retracted (stowed) position.

Metallurgical and dimensional analysis of the left hand actuator and the right hand actuator piston did not reveal any discrepancies.

The position of the left wing flight spoiler actuator showed that the panels were down. Although the left ground spoiler actuator was found unlocked and extended, the panel was crushed rearward along the leading edge, consistent with the damage exhibited by the flight spoilers.

1.17 Additional Information

1.17.1 Air Route Traffic Control Radar Data

The Washington ARTCC provided radar data and beacon reported altitude data from the NAS Stage-A track sort printout. The printout presented target locations in X and Y coordinates as a function of time.

Radar system coordinates for N500J are predicted target locations based on a comparison of actual target position (raw radar data) with previously predicted position. The comparison provided the radar tracker program with the information required to adjust predictions of target position for later times; however, the raw radar position information used in the comparison was not retained in the program. As a result, the target locations derived from track sort data probably differed from actual target position during heading and groundspeed changes, because the tracker program corrected the predicted target location based on comparison to raw data. Some degree of target undershoot and overshoot may have occurred before the predicted track could have been adjusted to coincide once more with the actual raw data position. Also, radar system tolerances contribute to uncertainties in the results of groundspeed computations. Therefore, with some exceptions, analysis of the aircraft's groundspeed and inertial accelerations based on track sort data is believed to be unreliable. These results, however, do not seriously affect an overall analysis of the aircraft's flightpath or its relationship to fixed positions in space. N500J's average groundspeed, based on projected distances from the runway, is presented in Appendix G, Performance Analysis.

The system coordinates were computed by adding the predicted value of a coordinate to the corrected data of that coordinate at the indicated time. The distances between the targets were computed and a plan view of the flight track was plotted. (See Appendix H.)

The beacon reported altitudes were taken directly from the track sort printout and tabulated in hundreds of feet mean sea level. (The tabulated altitudes have a tolerance of ± 100 feet because of the method of encoding pressure altitude and the method of correcting pressure altitude to m.s.l. altitude.) From these data an altitude profile was prepared. (See Appendix I.) Encoded altitude information would have been obtained from the captain's encoding altimeter had his transponder been used. If the copilot's transponder was used, encoded altitude information would have been obtained from the air data computer using the copilot's pitot static system.

The Safety Board considered N500J's average groundspeed of 343 kns between 1032:15.5 and 1034:03.5 to be reliable because of the straight line and equal distance between the computed targets. This segment of the approach occurred while the aircraft was descending from 11,000 ft to 6,000 ft. The winds aloft information disclosed that the aircraft would have encountered a headwind during this descent. Therefore, the aircraft exceeded the 250-kn indicated airspeed (KIAS) limit below 10,000 ft required by 14 CFR 91.70. The aircraft overshot the 245° localizer course to Hot Springs and maintained a shallow intercept track to the right of the localizer centerline to the LOM. After 1034:03.5, the calculated average groundspeed during the turn to final approach varied between 282 kns for a 20° bank angle and 319 kns for a 25° angle. The average groundspeed between the Armstrong Intersection and the LOM could have similarly varied from 210 kns for the 12.6 nmi straight line distance to 227 kns for the radar-developed curved flight track. Calculations of aircraft performance over relatively stable intervals between the vicinity of the LOM and impact were made to determine indicated airspeeds, flightpath angles, and rates of descent. The results show that indicated airspeeds varied between 163 and 168 kns. These values closely approximate the 170-kn full flap extension speed recommended by company procedures. These speeds were in excess of the recommended approach speeds of 137 to 147 kns (V_{ref}) + 5 to 15 kns. The associated flightpath angles varied from 3.75° to 4.46° and were steeper than the published 3.0° glide slope. The resulting high rates of descent, 1,125 ft per minute and 1,380 ft per minute, reflect the higher-than-expected airspeeds and flightpath angles.

Correlation of the altitude profile with the ATC transcript showed that the aircraft was leveled at 4,900 ft for at least 24 secs before descending at 1036:39.5. The copilot's report of leaving 5,000 ft 3 secs later disclosed that the encoded altitude (± 100) agreed with his altimeter. Except for the slight climb or leveloff after crossing the LOM, the aircraft was consistently below the glide slope with no correction to intercept it throughout the approach. The aircraft maintained an approximate 3.0° angle of descent and descended below DH about 2 nmi from the runway touchdown point. The flightpath angle for the last two radar track positions was 6° .

1.17.2 Air Traffic Control Procedures

The Hot Springs low sector controller failed to give the latest weather information to the flightcrew, contrary to paragraph 403 in the Air Traffic Control Handbook 7110.65, which states: "When an available official weather report indicates weather conditions are below a 1,000 foot ceiling or below the highest circling minimum, whichever is higher, or less than three-miles visibility for the airport concerned, transmit the weather report and changes classified as special weather observations to an arriving aircraft as part of the approach clearance...." However, the crew was on the same frequency when communications transpired between the controller and two aircraft who had made missed approaches and later diverted to other airports. Additionally, the crew ascertained that N8300E made a missed approach at Hot Springs and the controller had reported to another aircraft that no aircraft had yet landed at Hot Springs.

1.17.3 Company Flight Department Procedures

Johnson & Johnson's flight department did not have, nor was it required to have, a Flight Operations Manual. According to their flight operations manager, their pilots conformed to the following unwritten, company procedures. Upon investigation, it was found that these procedures were known and followed by company flightcrews.

The captain will fly the aircraft from the left seat at all times when passengers are on board.

During approaches under instrument meteorological conditions, the captain's attention will be inside the cockpit. The copilot will make the required callouts, monitor the instruments, and when near DH look for the runway environment.

The flight director will be used on all approaches unless an emergency precludes it. The captain can make either a coupled or a manual approach.

Required callouts: Outer marker, 1,000 feet above DH, 500 feet above DH, each successive 100-foot increment until DH, DH, and runway in sight. The copilot also calls out deviations from glide slope, localizer, airspeed, and any excessive rate of descent (more than 1,000 feet per minute).

When the airspeed is below 220 kn with the aircraft approaching the outer marker for an ILS approach, the flaps are lowered to 20°. The aircraft should then arrive over the outer marker at the proper speed for

landing gear and full flap extension (170 kts). From the outer marker to landing (final approach), the aircraft will be flown at V_{ref} ^{3/} plus 10 to 15 kts, gradually reducing to V_{ref} plus 5 to 10 kts, and maintaining a stabilized approach profile.

The altitude preselect controller will be set for the outer marker crossing altitude and upon arrival over the outer marker it will be set for the DH. At airports without a tower, the UNICOM will be used for traffic advisories and weather.

The captain is allowed to initiate an approach to an airport when the reported weather is below approach minimums."

The company reported that their flightcrews did not normally fly coupled approaches and that those pilots interviewed stated that the captain of N500J manually flew all approaches. The Safety Board also learned that the crew chief usually occupied the jumpseat during flight. Although, he had no assigned cockpit duties during the approach and landing sequence, he monitored aircraft instruments and settings, and frequently set the altitude preselect controller.

Although the company allowed a captain to initiate an approach when the reported weather was below approach minimums, they reported that this practice was executed primarily at airports which are known to have variable weather conditions.

The provisions of 14 CFR 91.117(b) permit a "look-see" approach even though the weather is below minimums. The pilot must execute a missed approach if, after arriving at the minimum descent altitude (MDA) or DH, he does not have the approach threshold in clear view and the aircraft is not in a position from which a normal approach to the runway can be made.

1.17.4 Flight Director Instrument System

The following is excerpted from the Sperry Rand SPI-73 Instrument System Pilot's Manual:

The Sperry SPI-73 instrument system presents an integrated display of all essential flight reference information. The display consists of the following flight data presented on three indicators--

^{3/} No. less than $1.3 V_s$.

- 1) The HZ-6B horizon flight director indicator--displays attitude reference data, fast/slow speed reference and radio displacement data for control of the aircraft pitch and roll attitude during all phases of flight.
- 2) The RD-100 radio direction indicator--displays the aircraft's position with respect to compass and radio navigational aids.
- 3) The C-6L gyrosyn compass indicator--displays the aircraft compass and VOR bearing information.

The mode selector switch controls the Z-14 flight director computer and determines the type of command information presented by the horizontal and vertical flight director command bars. When the command bars are centered, they designate that the aircraft is in the proper attitude to cause it to approach, intercept, and hold the selected flightpath. The computer contains monitor circuits which continuously access the validity of the computed roll and pitch commands. When the monitors detect a fault in the roll or pitch command circuits, the vertical and horizontal command bars are automatically retracted from sight.

The mode selector switch has six positions. The approach (APP) mode is selected for flying a front course ILS approach. The mode selector panel also contains an altitude hold switch (ALT) which places the Z-14 flight director system in the altitude hold mode, which commands the aircraft to acquire and hold the barometric altitude that existed when the switch was set to ON. Automatic switching functions within the computer set the ALT switch to OFF whenever the altitude hold mode is not compatible with the flight mode of the computer.

The horizon flight director indicator is equipped with a pitch select knob which provides manual selection of pitch command for climb or descent. The horizontal command bar can be set by use of the pitch knob whenever the flight director is not in the standby (SB) or ALT hold or has not captured the glide slope beam in the APP or APP manual modes. In-flight use requires that the aircraft to be maneuvered to the required pitchup or pitch-down attitude. The horizontal flight director bar is then set to center on the red dot of the miniature airplane symbol. The aircraft pitch attitude can now be held by keeping the bar centered on the red dot. (The horizontal command bar will then display pitch deviations relative to the miniature airplane symbol.)

The horizon flight director indicator contains a minimum descent altitude (MDA) annunciator which is illuminated in amber whenever the aircraft reaches the MDA selected on the radio (absolute) altitude indicator. (This system does not include an aural alert.)

The flight director system incorporates mode annunciators to identify the commands applied to the vertical and horizontal flight command bars and usually consists of two mode annunciator assemblies--one for pitch and one for roll. Each of them is capable of displaying up to five mode names with two colors of lights (amber and green). Additionally, each radio mode may have an added "armed" annunciator. (Johnson & Johnson reported that the mode selector in N500J incorporated pushbuttons which included the mode annunciator lights.)

The horizon flight director indicator shows glide slope displacement by means of a pointer which moves vertically over a fixed scale on the right side of the indicator. The data displayed are raw glide slope signals, obtained directly from the glide slope portion of the navigation receiver. The pointer remains out of view until the receiver is tuned to an ILS frequency or when a failure is detected in the glide slope circuits. Full-scale deviations of two dots above center and two dots below represent the upper and lower limits of the glide slope signal ($\pm 73^\circ$). The green gate display of one-half dot above and below represents the automatic approach capture range.

1.18 New Investigative Techniques

None

2. ANALYSIS

The crewmembers were certificated, trained, and qualified for the flight according to FAA regulations. They had adequate rest before reporting for duty.

The aircraft was certificated, maintained, and equipped according to FAA regulations. There was no evidence of structural failure. Although some components of the aircraft were outside the postcrash fire area and were damaged by fire, it is believed that these components were propelled from the main wreckage by the postcrash explosion. The left main landing gear outboard tire probably exploded and broke the wheel rim because of the intense ground fire and the remains were propelled to the locations shown on the wreckage distribution diagram. (See Appendix F.) Since

the main landing gear wheel wells adjoin and are open, any fire or smoke generated in one of those areas should leave evidence of that kind of damage in the other area. Since there was evidence of an explosion and since the right main landing gear and wing flap structure were not damaged by fire or smoke, the Safety Board concludes that an in-flight fire did not occur in the wheel wells. There was no evidence of an in-flight fire on any other structure or component of the wreckage.

The preflight preparations and weather briefing were adequate. Although the forecast did not indicate ceilings and visibilities as low as 100 ft and 1/8 mi, after 0900 the weather was at or below airport minimums of 500 ft above ground level and 3/4 mi visibility. Although the Hot Springs low sector controller failed to report the current weather to the crew, they had already received that report at 1021:36 from the Washington FSS and Charleston FSS, which showed Hot Springs to be below minimums. Since N500J was operating in the Hot Springs area on the appropriate frequency and was aware of the missed approach made by N8300E, the Safety Board concludes that the crew knew the airport was below minimums and was aware that the approach probably could not be completed successfully. Their decision to execute the approach did not violate regulations.

According to the plan view of the flight track, the aircraft overshot the Armstrong Intersection. The Cordonsville low sector controller informed the crew that they could maintain the 270° heading to join the localizer and proceed inbound to the airport. The captain should have initiated the turn onto the 243° localizer course as soon as he observed the proper indication on the flight director system. However, the aircraft continued on the 270° heading until the controller stated, at 1033:55, "N500J show you intercepting the ILS course now." Also, the aircraft did not slow to 250 kts as it descended below 10,000 ft, contrary to 14 CFR 91.70. The excessive speed was maintained during the turn to intercept the localizer which might have contributed to the overshoot. The excessive speed would have also rushed the crew through the approach and before-landing checklists and would have contributed to an unstabilized approach.

The calculated indicated airspeeds between the LOM and impact approximate the maximum speed for full flap extension and were in excess of the company's recommended approach and landing speeds by about 20 kts. Also, the calculated resultant flightpath angles and rates of descent exceeded those prescribed for the ILS approach. For the calculated groundspeed and prescribed glide slope of 3.0°, the rate of descent should have been 902 ft per minute, or 300 ft per minute less than the minimum calculated rate of descent.

According to the altitude profile, the aircraft descended below 5,000 ft prematurely, about 1.5 nmi outside the LOM, and crossed 400 to 500 ft below the minimum glide slope intercept altitude at the LOM. Company procedures required that landing flaps be extended 39° and the altitude preselect controller be positioned to DH when passing the LOM. Wreckage examination revealed that the flaps were at 20° and that the altitude preselect controller was at 5,000 ft. The flaps could have been extended to the landing position and subsequently retracted to the 20° position with the intention of executing a missed approach. However, the altitude profile shows no evidence of an attempted missed approach which could have been expected when the aircraft descended through DH. The fact that the flaps were found at 20° and the calculated indicated airspeed approximated the maximum speed for full flap extension suggest that only a low approach was contemplated. This indication is strengthened by the existing weather conditions, the length of available runway and the knowledge of a previous missed approach executed at Ingalls Field 5 minutes before N500J reported out of 5,000 ft.

The copilot's radio altimeter warning was found set to activate when the aircraft was 300 ft above ground level. The crew should not have relied on this instrument because of precipitous terrain underlying the approach. Therefore, it is significant that the preselect controller remained set at 5,000 ft. Outside of monitoring their barometric altimeters, the crew would have only been alerted by the radio altimeter which would have illuminated the MDA annunciator about 700 ft below DH.

The foregoing evidence, however, does not explain why the aircraft struck the ground 800 ft below the DH. Since the aircraft was descended prematurely, maintained nearly a constant descent angle below the glide slope, and struck the ground in a wings-level attitude 500 ft below the runway, the following possible causal or contributing factors were explored: (1) Aircraft control problems, (2) instrument error, and (3) flightcrew distraction and instrument misinterpretation.

Aircraft control problems.--The Safety Board considered in-flight ground spoiler deployment as a possible cause of the loss of altitude. Two of the three requirements for deployment of the ground spoilers--thrust levers at idle and ground spoiler switch "armed"--may have been satisfied near the LOM. However, the third requirement--compression of the landing gear squat switch--was not met. Only a short in the switch or wiring could have caused the unwanted deployment. Had ground spoilers deployed, the flight spoilers would have also deployed causing a significant deviation in the aircraft's descent profile. The crew would have been alerted to this situation and they would have pulled the deactivate handle, reducing the drag and causing another change in the descent profile. Also, had they experienced difficulty in stowing the spoilers, they could have reduced the drag by raising the landing gear and flaps.

There is no conclusive evidence of either of these situations having occurred. Examinations and tests of the spoiler panels and their associated components show that the panels were stowed when the aircraft struck the terrain. The flight track and altitude profile computed from the radar data failed to show significant deviations that could be associated with in-flight ground spoiler deployment, either symmetrical or asymmetrical. The swath through the trees was aligned with the runway.

Instrument error.--The low altitude of the aircraft throughout the approach suggests the possibility that the altimeter may have been reading higher than the actual altitude because of a blocked static port. If such were the case, the airspeed readings would also have been high. A pilot who is not aware of the blocked port would logically fly his selected indicated airspeed, but the actual airspeed, and consequently the groundspeed, would be lower. Since the groundspeed of N500J was high, a blocked static port probably did not exist. Also, the altitude profile shows that the aircraft was leveled at 4,900 ft which corresponded to the copilot's report of leaving 5,000 ft.

Flightcrew distraction and instrument misinterpretation.--Distractions can disrupt a flightcrew's instrument scan and lead to misinterpretation of the information presented by the flight instruments. One cause of distraction could have been abnormal engine instrument indications. The Board's investigation disclosed evidence that the HP bleed air tapping pipe may have been improperly installed in the bypass duct and diffuser case of the No. 2 engine. The Board finds the Rolls-Royce report of examination contradictory in that, had the assembly become uncoupled by tilting action, one would expect to see shearing of the pipe threads in opposite directions. The deformation was at an angle to the thread plane and the threads were sheared primarily in one direction which indicate that the pipe was pulled out of the nut at an acute angle. Also, the sleeve and spacer ring remained misaligned within the pipe assembly, and markings on the inside diameter show evidence of misalignment of the spacer ring. The silver protective coating was evident only in the grooves of the undamaged threads. Had the assembly been coupled properly, the coating should have been removed uniformly.

Assuming that it was disconnected or misaligned and leaking, a loss of bleed air would result. Bleed air would have entered the bypass duct and would not have illuminated any overheat or fire warning annunciators. This loss of pressure would not necessarily affect the pneumatic system since the left engine would automatically continue to supply pressure. But, it would affect the fuel control regulator and result in a loss of thrust. The extent of its effect on engine performance would depend upon the amount of loss and throttle position which would also vary the No. 2 engine instrument readings. The abnormal readings

might be sufficient to distract the crewmembers. This irregularity probably would not have been reported to ATC. The actual effect on engine operation would have been minimal during the descent and more pronounced had full power been used for a missed approach. It should not have prevented the crew from arresting the descent. The descent profile does not indicate an attempted missed approach.

The test conducted by Cooper Airotive, Inc., only shows the anticipated reduction in available engine thrust caused by a loss of bleed air. An uncowed engine was used which permitted the pipe assembly to be propelled outward under high pressure, and the material of the bypass duct ruptured once it was sufficiently weakened by the high temperature. Movement allowed the sleeve and spacer ring to become dislodged. This did not occur in the No. 2 engine in N500J.

Company procedures permitted coupled approaches, but such approaches were not flown frequently. Based on the company's report, the Safety Board believes that the captain was probably making the final approach (LOM inbound) manually. Regardless of the approach method, data presented on the horizon flight director indicator may have been misunderstood.

According to the only available altitude profile, the aircraft descended prematurely precluding flight director capture of the glide slope. Use of the altitude hold function would not have prevented the horizontal command bar from moving to a "fly-up" indication because the descent was made manually and the bar would have shown a pitch down deviation independent of the glide slope signal. The amount of horizontal command bar deviation from level flight would depend upon the original position of the bar selected by the captain with the use of the pitch select knob and the amount of elevator control input. Even if the mode selector was placed in the APP mode, the bar would not have displayed commands with respect to the glide slope because it had not been captured. The horizontal command bar could have been approximately centered, misleading the pilot into believing that the aircraft was on the glide slope. However, the glide slope raw data pointers on both the horizon flight director indicator and RD-100 would have been in view momentarily at the top, indicating that the aircraft was two dots or more below the glide slope. The amber "armed" annunciator light should have also alerted the crew that the glide slope had not been captured. If they had been distracted, they would have had to ignore their altimeters, raw data, the "armed" light, outer marker light and radio compass information which would have enabled the crew to determine their position during the approach. If the captain had been relying on the MDA annunciator, it would not have illuminated until the aircraft was 700 ft below DH or 400 ft below the runway TDZ.

Although the evidence gathered indicates the accident sequence began as the aircraft descended below 5,000 ft in the vicinity of the LOM, the Safety Board could not determine the reason for the premature descent nor could it explain why the aircraft was consistently below the glide slope with no evidence of an attempt to capture the glide slope or execute a missed approach.

A cockpit voice recorder and flight data recorder would have provided invaluable assistance in identifying the causal factors in this accident.

3. CONCLUSIONS

3.1 Findings

1. The crew was qualified for the flight. There was no evidence found of pre-impact illness or incapacitation of the crew or passengers.
2. The aircraft was certificated and maintained in accordance with applicable regulations.
3. Although the Hot Springs low sector controller failed to provide the flight with the latest weather report in accordance with Air Traffic Control Handbook 7110.65, the crew was aware that the weather at the airport was below landing minimums.
4. The aircraft's speed was about 343 kts below 10,000 ft; this speed exceeded the 250-kn limit.
5. The crew was aware of the minimum altitude outside the LOM.
6. The altitude preselect controller was not positioned to the DH as required. The copilot's radio altimeter was set to DH.
7. The aircraft was consistently below the glide slope.
8. The crew did not demonstrate altitude awareness from the vicinity of the LOM to impact.
9. The ground and flight spoilers were down at impact and there is no evidence in either the ground track, profile track, or the wreckage site to suggest either symmetrical or asymmetrical deployment in flight.

10. There may have been a loss of thrust from the right engine and crew distraction caused by abnormal engine instrument indications; however, these, by themselves, should not have prevented the crew from executing a missed approach.
11. The crew did not report any malfunctions or difficulties.
12. The ILS system was functioning within prescribed limits at the time of the accident.

3.2 Probable Cause

The National Transportation Safety Board could not determine the probable cause of the aircraft's descent below decision height and impact with terrain 500 ft below the elevation of the runway.

4. RECOMMENDATIONS

None.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

/s/ KAY BAILEY
Acting Chairman

/s/ FRANCIS H. McADAMS
Member

/s/ PHILIP A. HOGUE
Member

/s/ JAMES B. KING
Member

February 9, 1978

5. APPENDICES

APPENDIX A

Investigation and Hearing

1. Investigation

The National Transportation Safety Board was notified of the accident at 1130 e.d.t., September 26, 1976. Investigators were dispatched immediately to Hot Springs, Virginia.

Working groups were established for operations, air traffic control, weather, structures and systems, powerplants, and maintenance records.

Parties to the investigation were the Federal Aviation Administration, Johnson & Johnson, Inc., Grumman American Aircraft Corporation, Rolls-Royce, Ltd., National Business Aircraft Association, Inc., and Professional Air Traffic Controllers Organization.

2. Public Hearing

A public hearing was not held.

APPENDIX B

Crew Information

Captain Richard A. Hopkins

Captain Richard A. Hopkins, 54, was hired by Johnson & Johnson, Inc., on November 2, 1968. He completed his initial training in the Gulfstream II on October 29, 1974. He held Air Transport Pilot Certificate No. 408774; he was type rated in the DC-3, CV 240/340/440/580, L-1329, and G-1159, and held commercial privileges for rotorcraft/helicopter, single-engine land, and single-engine sea. He held a valid flight instructor certificate and was an approved FAA examiner in the L-1329. His first class medical certificate was issued May 5, 1976, with the limitation that the holder possess glasses for near vision. He had accumulated 16,982 flight-hours, of which 523 were in the Gulfstream II. His total instrument time was 1,555 hours, 155 hours of which were in simulated instrument conditions. He had logged 5.4 hours of actual instrument time and seven ILS approaches since July 1976.

First Officer Rodger M. Oliver

First Officer Rodger M. Oliver, 40, was hired by Johnson & Johnson, Inc., on March 8, 1965. He completed his Gulfstream II training on October 29, 1974, and had passed annual flight checks in the Gulfstream II on October 22, 1975, and in the L-1329 on April 26, 1976. He held Commercial Pilot Certificate No. 1665577 with ratings for airplane single- and multiengine land and instrument. His second-class medical certificate was issued February 2, 1976, with no limitations. He had accumulated 2,700 flight-hours, of which 245 were in the Gulfstream II. His total instrument time was 200 hours, all of which was in actual instrument conditions.

Crew Chief Robert E. Moriarty

Crew Chief Robert E. Moriarty, 56, was hired by Johnson & Johnson, Inc., on January 26, 1959. He held an airframe and powerplants certificate. His duties included preflight and postflight inspection of the aircraft and monitoring of the aircraft instruments from the jumpseat. Although he was not rated as a flight engineer, he had accumulated 3,200 flight-hours in the Gulfstream II.

Controller Information

Joseph Tomassetti, the Hot Springs low sector radar controller, was employed by the FAA in January 1967 and became a full performance controller in July 1970. His last semi-annual overshoulder evaluation was April 4, 1975, and his last semiannual written examination was November 17, 1975. His class II medical certificate was issued September 16, 1975.

APPENDIX B

Gregory Hattland, the handoff position controller, was employed by FAA in April 1968 and became a full performance controller in July 1970. His last semiannual overshoulder evaluation was September 3, 1975, and his last semiannual written examination was November 1975. His Class-II medical certificate was issued October 1975.

Richard Wise, the manual position controller, began employment with FAA August 1970 and became a full performance controller in March 1974. His last semiannual overshoulder evaluation was in March 1974. His Class II medical certificate was issued January 1975.

APPENDIX C

Aircraft Information

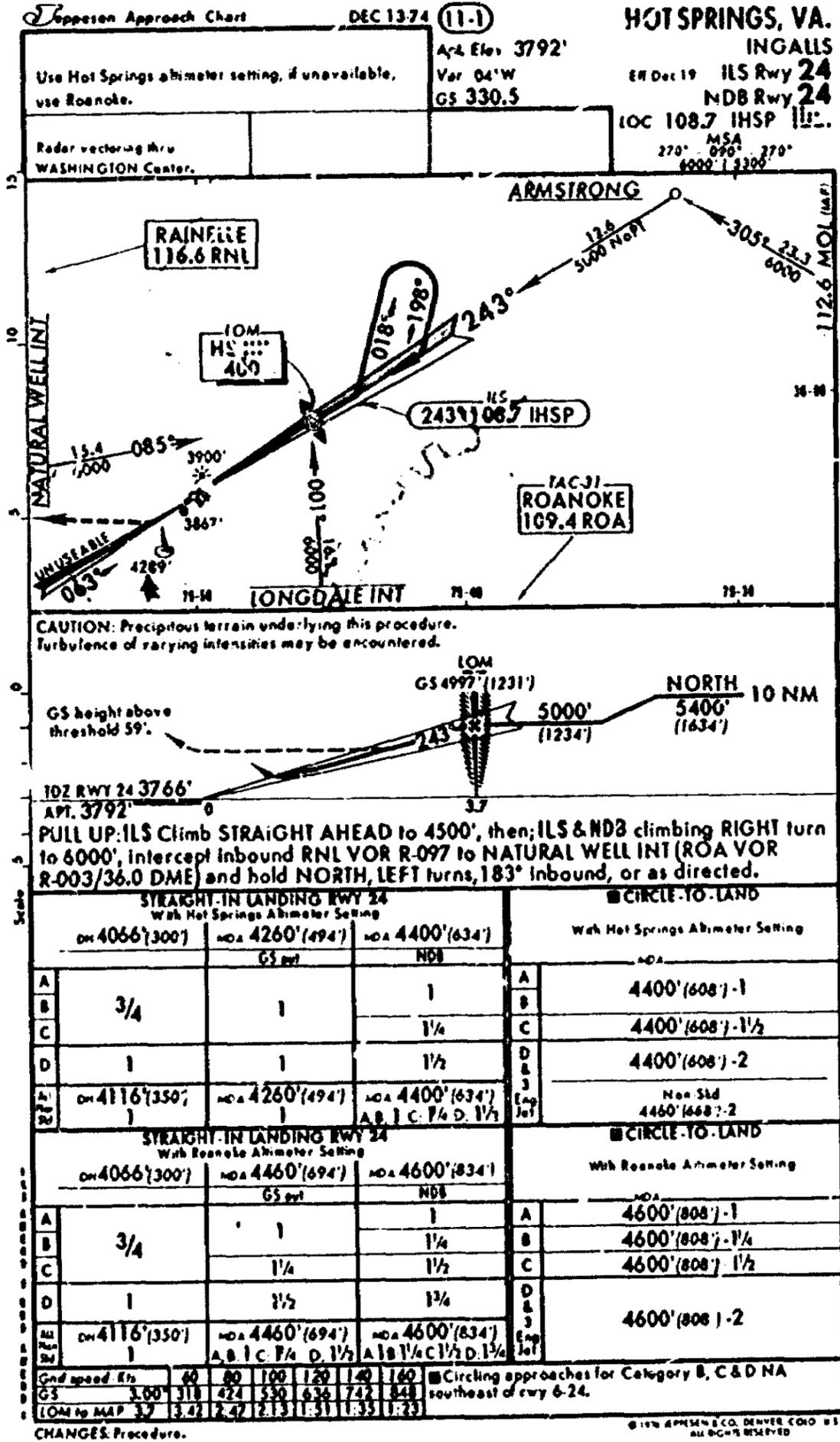
The aircraft was Grumman Gulfstream II (G1159), N500J, manufacturer's serial No. 50. It was manufactured June 28, 1969. The aircraft had accumulated 3,216 hours in service, including 29 hours since the last major inspection on September 9, 1976, and 1 hour since the last line maintenance check on September 20, 1976.

The aircraft was equipped with two Rolls Royce 511-8 engines.

Engine serial numbers and times follow:

<u>Engine</u>	<u>Serial No.</u>	<u>Total Time</u>	<u>Time Since Overhaul</u>
No. 1	8637	3,216 hours	Total since new
No. 2	8638	3,072 hours	230 hours

APPENDIX D



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

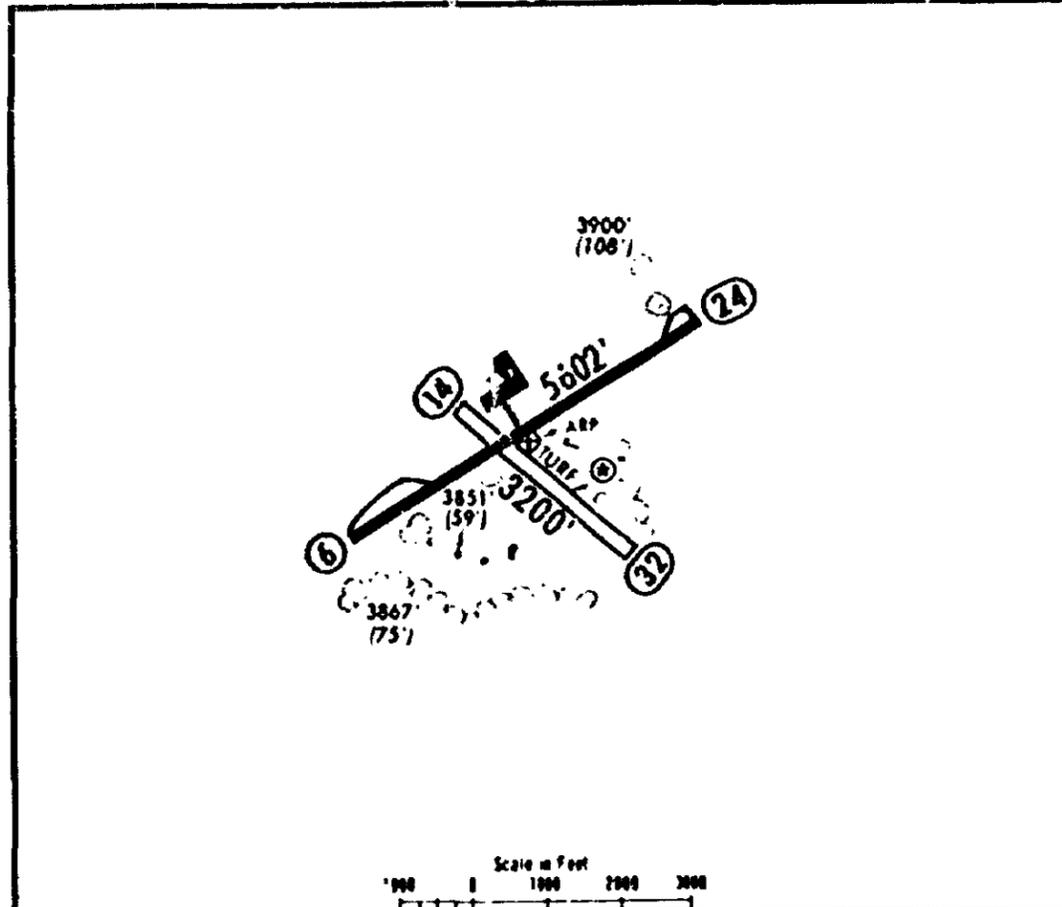
APPENDIX E

HOT SPRINGS, VA.
INGALLS FIELD
 Elev 3792' N37 57.1 W09 50.0

(11.1) DEC 1374

Jeppesen Approach Chart

HSP UNICOM 122.8



ADDITIONAL RUNWAY INFORMATION

RWY	LIGHTING	USEABLE LENGTHS			WIDTH
		LANDING Threshold	BEYOND Glide Slope	TAKE OFF	
6 24	MIRL REE ● AVASI-L		4502'		100'
14 32					200'

● On request thru UNICOM.

	AIR CARRIER TAKE-OFF			ALTERNATE
	TAKE OFF ALTN FIELD WITHIN 15 Min. Push 30 Min. L. time	TAKE OFF ALTN FIELD WITHIN 1 Hr. 2 Eng 2 Hr. 3 & 4 Eng	TAKE OFF ALTN NOTIFIED	
21 to 24 hrs	1/2	1	1	NA
21 to 24 hrs	1/4	1	Landing Weather Minimo	
24 to 48 hrs	1/4	1/2		

● IFR departure procedure: Rwy 24, climb on heading of 276' to 5000' before proceeding on course, rws 14 & 32, climb on runway heading to 5000' before proceeding on course.
 ● IFR Part 135 Operators 3/4 authorized rwy 24.

CHANGES take off notes.

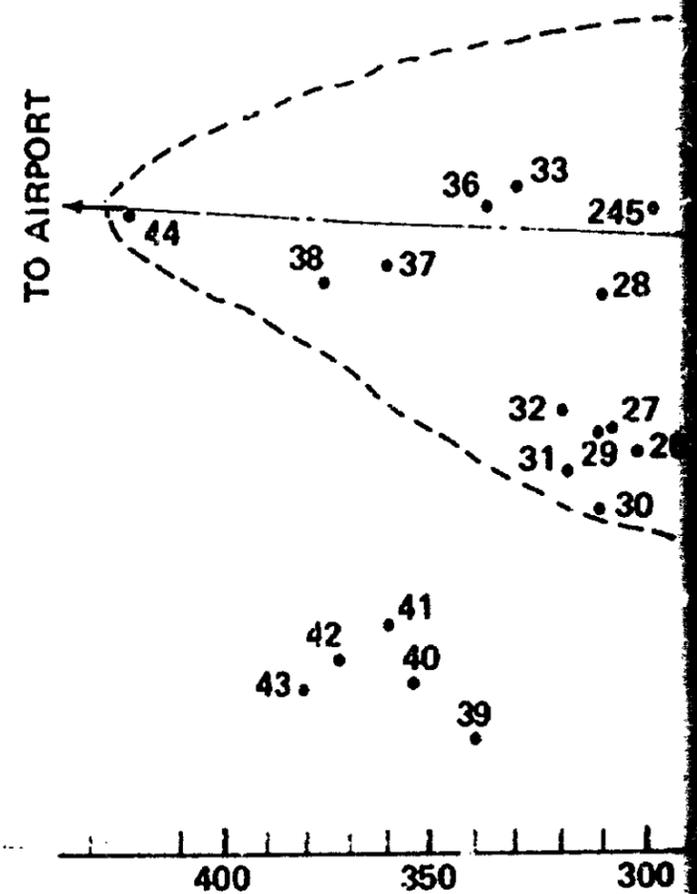
© 1974 JEPPESEN, INC. DEPT. OF AIR FORCE, WASHINGTON, D.C. 20330

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

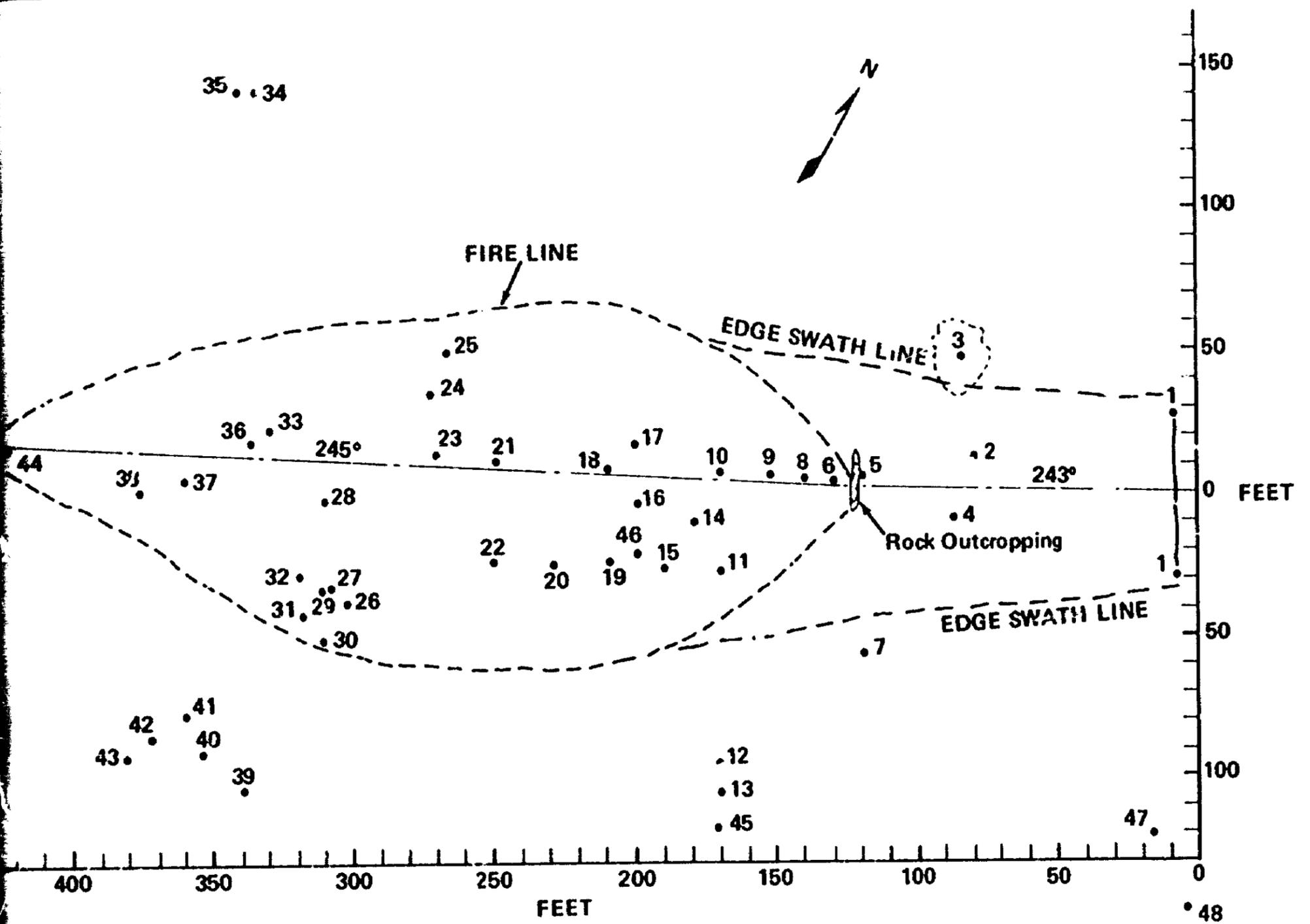
LEGEND

35 • 34

1. Left and Right Navigation Light Lenses, Pieces of Wing Structure
2. Wing and Flap Structure
3. Indications of Raw Fuel in Foliage
4. Wing and Flap Structure
5. Right Main Landing Gear, Wheels and Tires
6. Section of Nose Wheel Rim
7. Left Engine Reverser
6. Fuel Tank Cap
9. Right Landing Gear Sponson Rib, Wing Section, Flap Jackscrew
10. Section of Right Flap
11. Section of Left Wing
12. Long Range Oxygen Bottle
13. Engine Hot-Air Valve
14. Left Wing Ground Spoiler
15. Left Main Landing Gear with Sponson Rib
16. Left Wingtip
17. Right Main Landing Gear Uplock, Section of Wing Rear Beam
18. Right Wingtip, Piece of Right Flap
19. Complete Empennage, One Battery, Water Separator, Left Landing Gear Door Retract Mechanism
20. Part of Left Horizontal Stabilizer
21. Right Landing Gear Side Brace
22. Left Engine
23. Right Landing Gear Strut with Trunnion
24. Ten Ft Section of Right Wing with Fence, Both Flight Spoilers Attached
25. Section of Right Flap with Broken Jackscrew
26. Fuselage Station 44 Bulkhead, with Nose Gear Door Retract Cylinder
27. A.P.U.
28. Pedestal Controls, Main Entrance Door Steps, Electrical Wiring
29. Right Engine
30. Center Section Fuselage, Sta. 345 to 452
31. Two Gyres
32. I.N.S. Box
33. Right Engine Bleed Valve
34. Sun Visor
35. Piece of Sound Proofing App. 20" x 20"
36. D.M.E. and other Radio Equipment
37. Main Entrance Door Guard Rail
38. Main Entrance Door Latch
39. Lavatory Door
40. Galley Equipment
41. Two Cabin Seats
42. Galley Food Storage Container
43. No. 2 Left Emergency Exit Window
44. Half of Oxygen Bottle
45. Left Landing Gear Fixed Door
46. Burnt Left Inboard Main Tire & Steel Beads

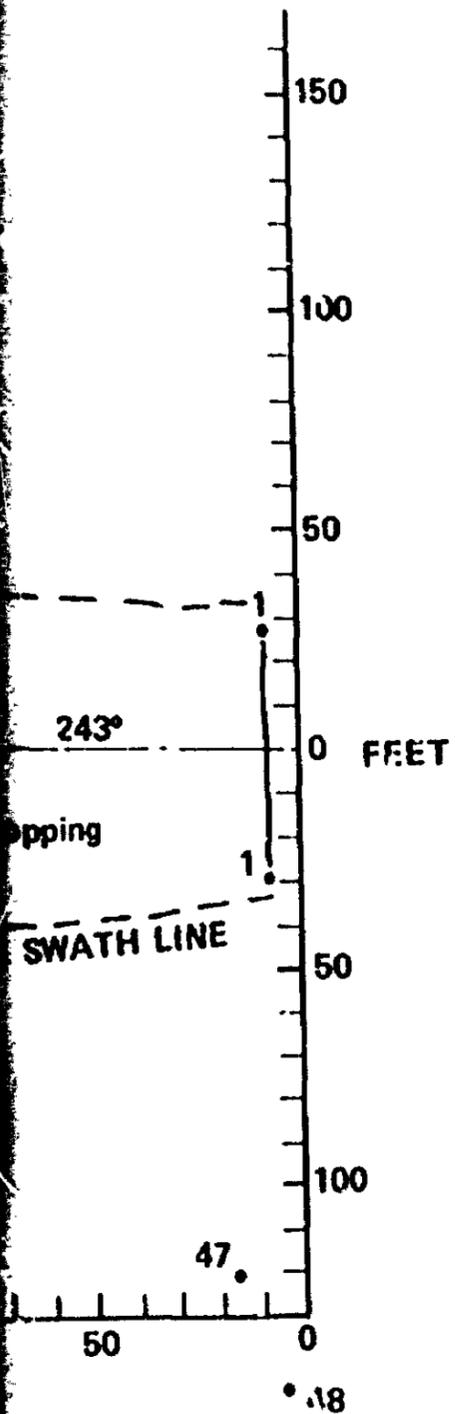


47. Part of Outer Flange Left Outboard Main
48. Burnt Left Outboard Main Tire & Steel Beads



of Outer Flange Left Outboard Main Wheel
 at Left Outboard Main Tire & Steel Beads

APPENDIX F



**NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.**

**WRECKAGE DISTRIBUTION CHART
JOHNSON & JOHNSON
GRUMMAN GULFSTREAM II, N500J
INGALLS FIELDS AIRPORT, HOT SPRINGS, VIRGINIA
SEPTEMBER 26, 1978**

JOHNSON & JOHNSON G-1159 AIRCRAFT PERFORMANCE
INGALLS FIELD, VIRGINIA, SEPTEMBER 26, 1976

TIME 1 ^R MIN SEC GMT (-1 HRS TO LOCAL)	TARGET DISTANCE FROM END RWY 24 (N.M.)	MODE "C" ALT (FT MSL)	MINIMUM ALTITUDE (FT MSL) ^{2/}	ALTITUDE DIFFERENCE (FT) ^{3/}	AVERAGE SPEED ^{4/}		AVERAGE RATE DESCENT (FT/MIN) ^{4/}	AVERAGE FLIGHTPATH ANGLE (DEGREES) ^{4/}	REMARKS
					GROUND (KTS)	INDICATED (KTS)			
1436:03.5	6.40	5,000	5,000	0					
15.5	5.87	4,900	5,000	-100					↓ Level Flight
27.5	5.34	4,900	5,000	-100					↓
39.5	5.00	4,900	5,000	-100	↑	↑	↑	↑	
51.5	4.40	4,700	5,000	-300					1436:42 "Five hundred juliet's out of five"
1437:03.5	4.02	4,600	5,000	-400					Outer Marker, 3.5 n.m. from end runway
15.5	3.56	4,500	5,000	-500					
27.5	3.00	4,600	4,779	-179	↑	↑	↑	↑	
39.5	2.77	4,500	4,706	-206	164	158	933	3.22	
51.5	1.79	no report	4,394	-		170	163	1125	3.75
1438:03.5	1.43	4,000	4,279	-279	175	168	1380	4.46	Decision Height, 4,066 ft. msl
15.5	0.74	3,700	4,060	-360	↓	↓	↓	↓	
27.5	0.09	3,200 ^{1/}	4,060	-840	↓	↓	↓	↓	

- ^{1/} Elevation of impact 0.10 n.m. from end of runway.
^{2/} Published on approach procedure (5,000 ft.) and altitudes on 3° glide slope
^{3/} Mode "C" altitude minus minimum altitude. Minus value indicates below minimum altitude.
^{4/} Average calculated value over distances and altitudes shown in columns 2,3.

DATA SOURCE
Washington ARTCC
radar data.

APPENDIX G

TRUE NORTH

NATIONAL TRANSPORTATION SAFETY BOARD
 WASHINGTON, D.C.

FLIGHT TRACK
 (NAS STAGE "A" DERIVED)
 JOHNSON & JOHNSON
 GRUMMAN G-1159, N500J
 INGALLS FIELD, HOT SPRINGS, VA.
 SEPTEMBER 26, 1976

CENTER - FIVE HUNDRED JULIET SHOW
 (1433:55) YOU INTERCEPTING THE ILS
 COURSE NOW

38°05.6'N

LATITUDE

37°59.2'N

37°57.3'N

IMPACT SITE

END RUNWAY 24

INGALLS FIELD, HOT SPRINGS, VA.
ELEVATION: 3792 FEET

LOCATOR OUTER MARKER

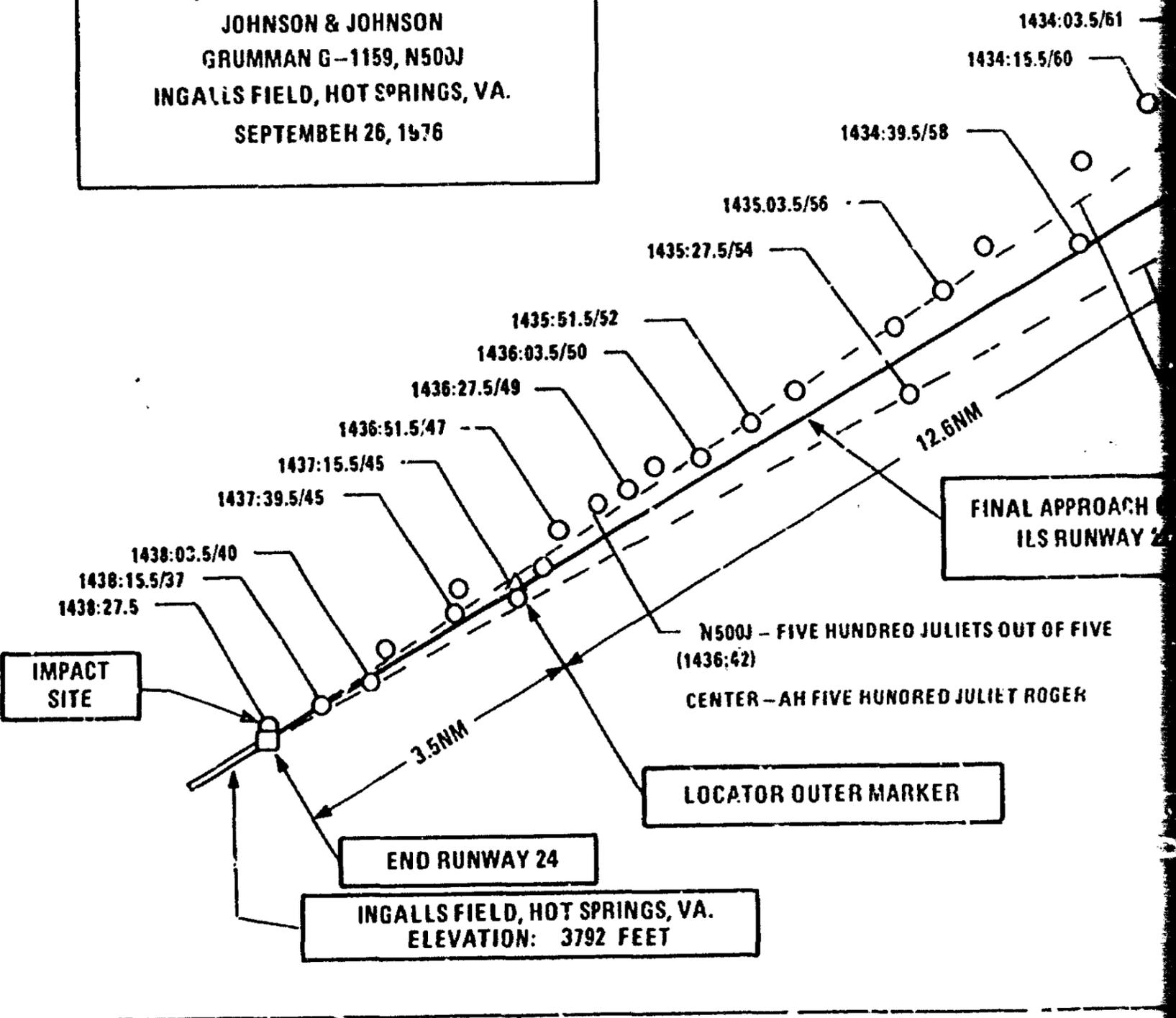
FINAL APPROACH ILS RUNWAY 24

N500J - FIVE HUNDRED JULIETS OUT OF FIVE
 (1436:42)
 CENTER - AH FIVE HUNDRED JULIET ROGER

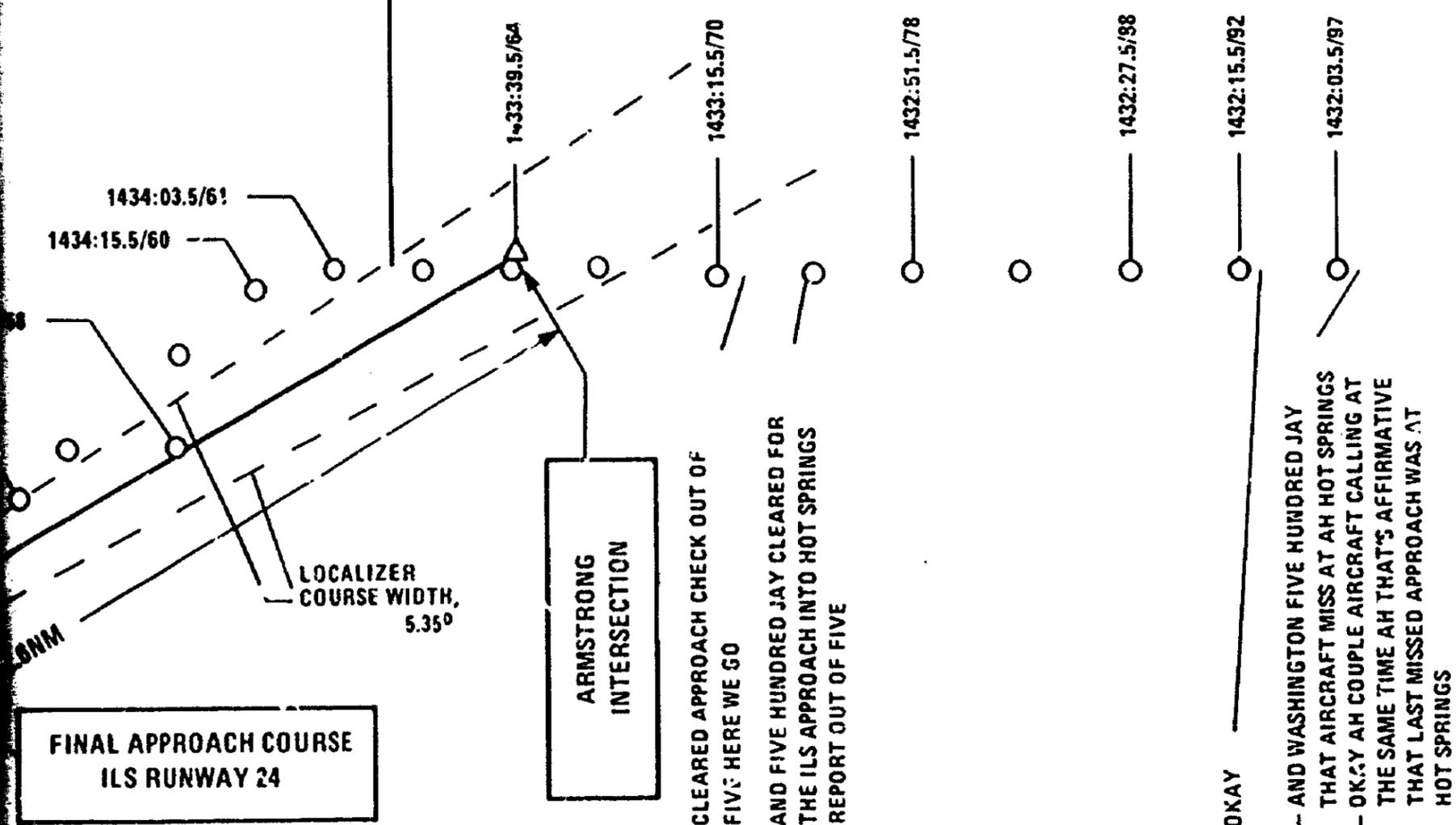
79°49.5'W

79°45.6'W

LONGITUDE



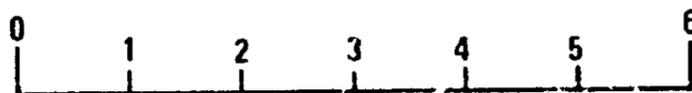
FIVE HUNDRED JULIET SHOW
YOU INTERCEPTING THE ILS
COURSE NOW



LIETS OUT OF FIVE

D JULIET ROGER

ER

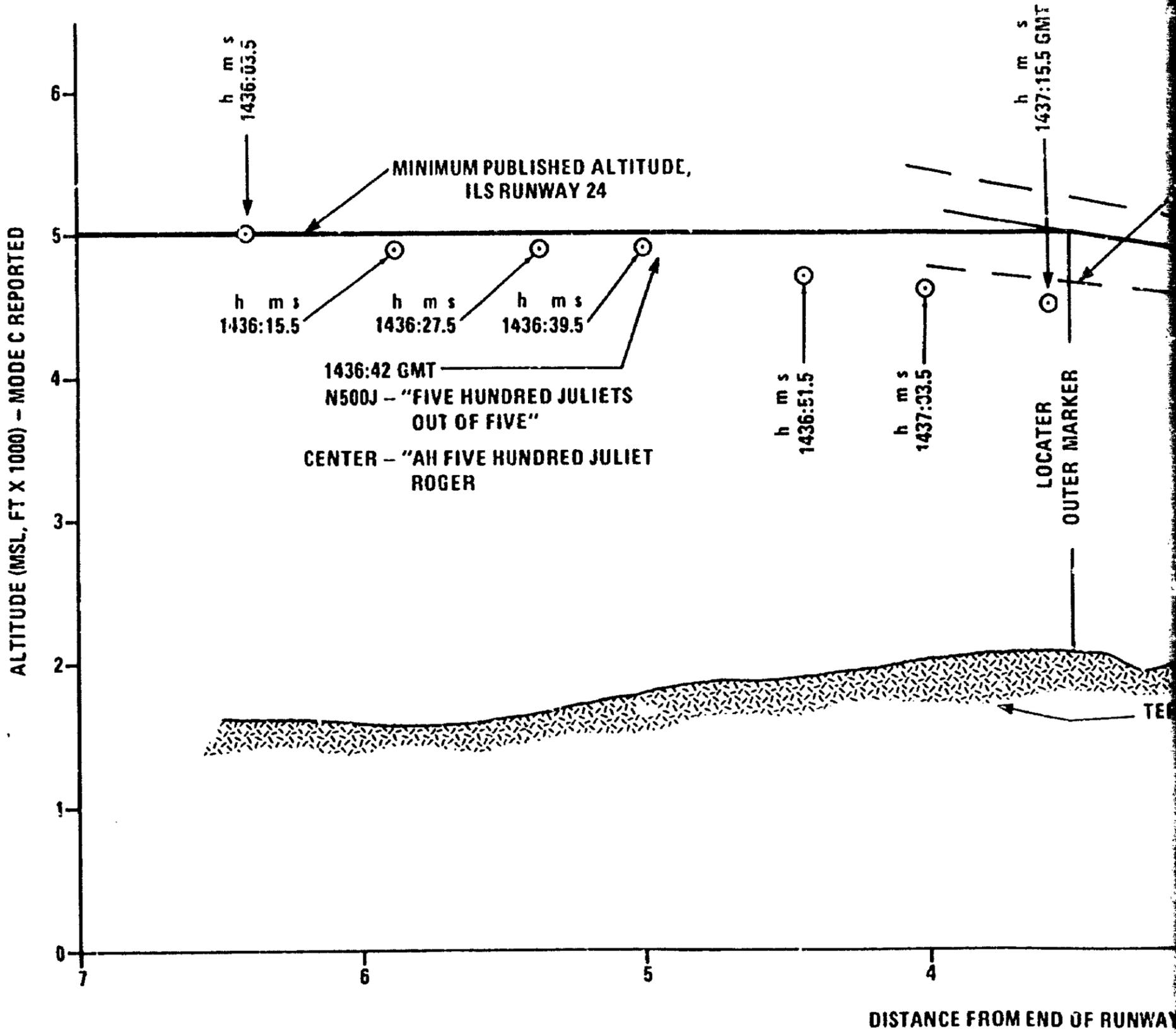


SCALE: ~ NAUTICAL MILES

○ NAS STAGE "A" TRACK SORT COORDINATES; 12 SECOND INTERVAL
XXXX:XX/XX TIME(HRS, MIN:SEC - GMT) /ALTITUDE(HUNDREDS OF FEET)

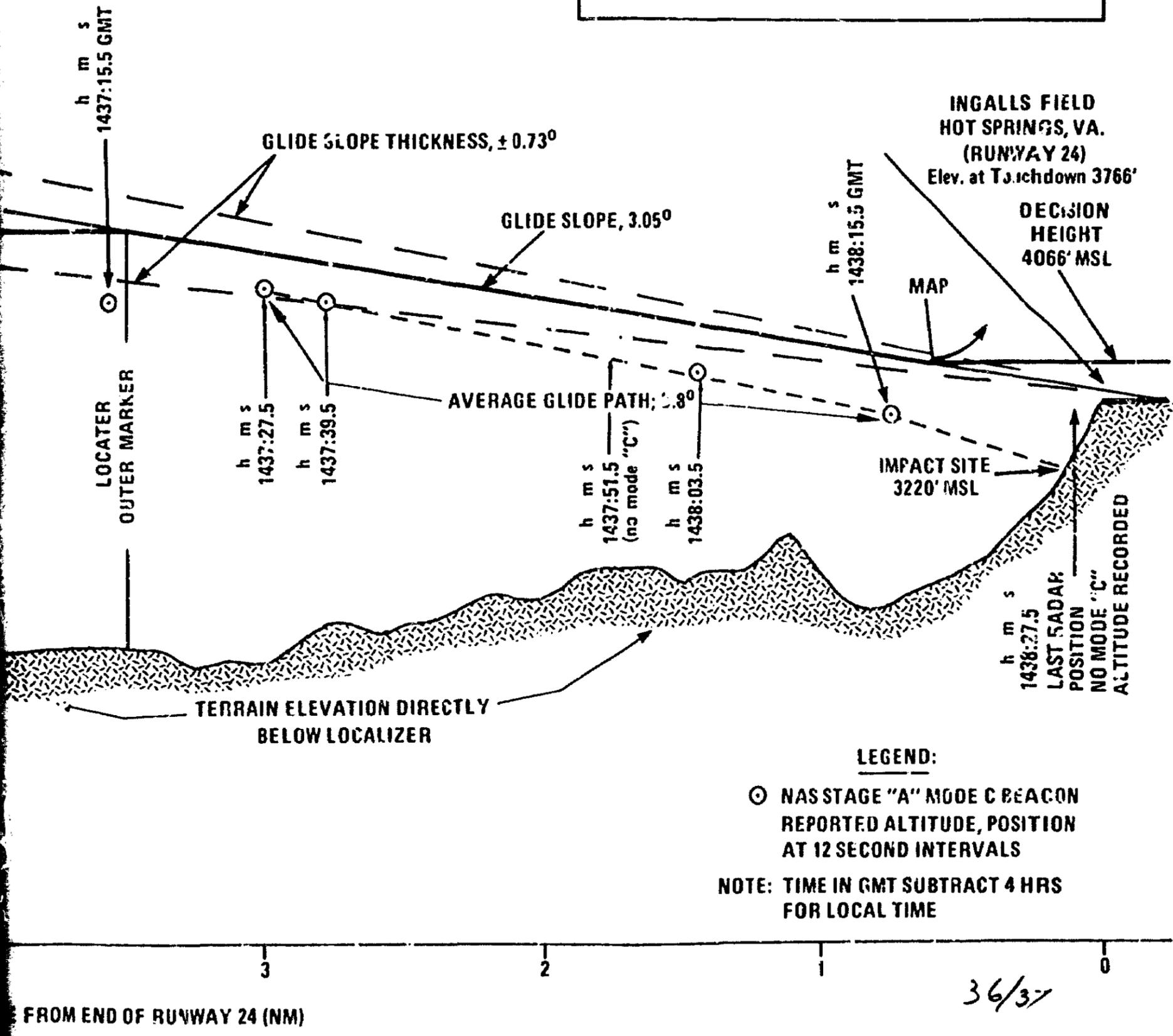
79°32'W

34/35



NATIONAL TRANSPORTATION SAFETY BOARD
 WASHINGTON, D.C.

ALTITUDE PROFILE
 (NAS STAGE "A" DERIVED)
 JOHNSON & JOHNSON
 GRUMMAN G-1159, N500J
 INGALLS FIELD, HOT SPRINGS, VA.
 SEPTEMBER 26, 1976



LEGEND:

⊙ NAS STAGE "A" MODE C BEACON REPORTED ALTITUDE, POSITION AT 12 SECOND INTERVALS

NOTE: TIME IN GMT SUBTRACT 4 HRS FOR LOCAL TIME

36/37

FROM END OF RUNWAY 24 (NM)