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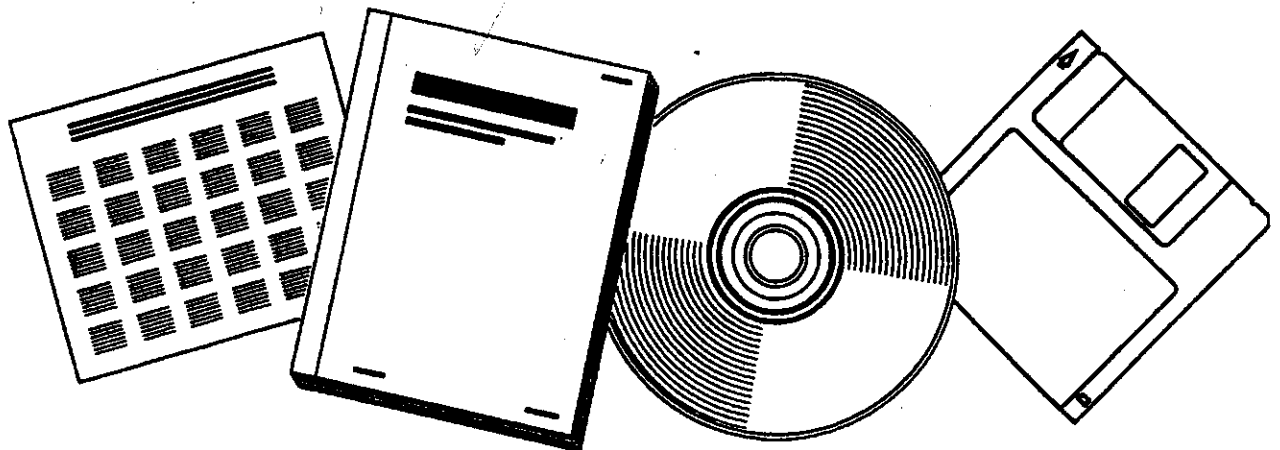
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**AIRCRAFT ACCIDENT REPORT. LEAR JET
CORPORATION, LEAR JET MODEL 23, N804LJ,
JACKSON, MICHIGAN**

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

21 OCT 1965



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**U.S. DEPARTMENT OF COMMERCE
National Technical Information Service**

AIRCRAFT ACCIDENT REPORT

Adopted: December 11, 1967

LEAR JET CORPORATION
LEAR JET MODEL 23, N804LJ

Jackson, Michigan

October 21, 1965

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
WASHINGTON D.C. 20591

LEAR JET CORPORATION
LEAR JET MODEL 23, N804LJ
JACKSON, MICHIGAN
OCTOBER 21, 1965

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SYNOPSIS

A Lear Jet Model 23, N804LJ, operated by the Lear Jet Corporation crashed eight miles east-northeast of Jackson, Michigan, at approximately 1935 e.s.t., on October 21, 1965. The pilot and copilot were killed. There were no passengers. The aircraft was destroyed by impact.

The flight was operating in accordance with an Instrument Flight Rules flight plan from Detroit, Michigan to Wichita, Kansas, at an assigned altitude of Flight Level 250. The radar controller working the flight established radar contact at 1933, and observed the target traveling in a southwest direction ". . . when the aircraft started a sharp turn to the right (i.e. north) (sic). As the aircraft passed through a northerly heading the beacon target disappeared from the radar." The aircraft was traversing an area of moderate to severe turbulence when it deviated from the assigned route.

The Board determines that the probable cause of this accident was a loss of adequate attitude reference resulting from AC electrical power failure under night, turbulent conditions.

1. INVESTIGATION

1.1 History of the Flight

N804LJ, a Lear Jet Model 23, was operated by the Lear Jet Corporation to provide transportation for a company official from Wichita, Kansas, to Detroit, Michigan, on October 21, 1965. The aircraft arrived at Detroit Metropolitan Airport at approximately 1733. ^{1/} The company official, who remained in Detroit, reported that the pilot had mentioned a possible yaw damper problem during descent. He further stated, ". . . after we had landed and were taxiing into the executive terminal in Detroit I mentioned to (the pilot) the fact that I didn't notice the roughness he thought he might encounter, and he said no, the yaw damper seemed to be functioning all right."

Following a briefing by a Weather Bureau (WB) meteorologist, the crew filed an Instrument Flight Rules (IFR) flight plan for the return trip to Wichita. They estimated a time en route of 2:40 hours with 3:30 hours of fuel on board, and requested a cruising altitude of Flight Level (FL) 410. At 1858 an IFR clearance was delivered to the flight. After some delay due to conflicting ground and airborne traffic N804LJ departed on Runway 03L at 1925. Four minutes later radio contact was established with Cleveland Air Route Traffic Control Center (ARTCC). The crew reported climbing through FL 180 to the assigned FL 250, and repeated an earlier request to Departure Control that they be cleared to climb ". . . as soon as possible." At 1931 the flight reported level at FL 250. At 1932 they were assigned a new frequency for communications with Cleveland ARTCC. The acknowledgement of the new frequency was the last transmission received from N804LJ.

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

The Federal Aviation Agency (FAA) controller stated that: "(N804LJ) . . . was handed off to me by the Jackson Departure radar controller at approximately (1933). The aircraft at that time was approximately 25 nautical miles east-northeast of the Jackson, Michigan VOR and heading approximately 250 degrees.

"I placed a radar marker on the aircraft target and followed it for about ten miles to the southwest when the aircraft started a sharp turn to the right (i.e. north) (sic). As the aircraft passed through a northerly heading the beacon target disappeared from the radar. I immediately turned up the normal radar gain but never saw the aircraft on radar again."

Witnesses in the vicinity of the crash site generally described seeing a large ball of fire followed by many burning parts falling in an umbrella or fan-shaped pattern.

The accident occurred during hours of darkness about eight miles east-northeast of Jackson, Michigan, at approximately 42°19'30" N Latitude, 84°17'30" W Longitude. The elevation was approximately 1,050 feet.

1.2 Injuries to Persons

<u>Injuries</u>	<u>Crew</u>	<u>Passengers</u>	<u>Others</u>
Fatal	2	0	0
Nonfatal	0	0	0
None	0	0	

1.3 Damage to Aircraft

The aircraft was destroyed by impact.

1.4 Other Damage

None.

1.5 Crew Information

Glen E. David, age 32, was pilot-in-command and possessed commercial pilot certificate No. 1398585 with ratings for airplane single and multi-engine land and instruments. He was issued a letter of competency in the Lear Jet Model 23, by the FAA on May 1, 1965. At the time of the accident he was Chief Production Test Pilot for the Lear Jet Corporation and had accumulated 3,419 total flying hours, of which 2,135 hours were in single engine jets. His total time in the Lear Jet was 642 hours. Mr. David's last FAA second-class medical certificate was issued on September 28, 1965, without limitations. Pilot David's activity for the preceding 24-hour period included a flight which ended at 1600, October 20, and normal duties on the day of the accident.

Copilot Lawrence V. Bangiola held commercial pilot certificate No. 408720 with airplane single and multiengine land, single engine sea, and instrument ratings. He also possessed a flight instructor rating and a ground instructor certificate. His flight certificates were reissued in 1958 with added ratings in the DC-3 and Lockheed 18. At the time of the accident he had accumulated 8,460 total flying hours, of which 22 hours were in the Lear Jet. His last FAA second-class medical certificate was issued on June 16, 1965, without limitations. Pilot Bangiola had not flown in the 24-hour period prior to departure from Wichita.

1.6 Aircraft Information

N804LJ, Lear Jet Model 23, S/N 004 was manufactured by the Lear Jet Corporation and purchased by Mr. Robert J. Graf, Ft. Lauderdale, Florida, on

November 13, 1964. It was operated by the owner and the Lear Jet Corporation, under lease, until September 10, 1965, when it was returned to the Lear Jet facility for modification and updating to new S/N 015A. This involved the installation of several service kits and the replacement of approximately 85 percent of the electrical wiring.

The Manager of Quality Control at the Lear Jet Corporation reported that the company service organization was not staffed sufficiently to accomplish such a major modification at that time. Accordingly, it was decided that the electrical updating would be accomplished by production personnel using an Operation and Inspection Record (O & IR) under the supervision of production quality control supervisors. The necessary mechanical functions associated with the electrical updating, installation of service kits, and the shakedown and functional tests of other systems would be accomplished by service personnel using a Service Work Order Log. The aircraft would then be prepared for flight by the Flight Ground Department. In these areas the inspection authority rests with FAA-Designees holding an Inspection Authorization. The manager stated, "Here the controlling authority is strictly FAR 43 and 91 and the use of regular production flight forms is not mandatory in this case. The only requirement in this type of operation with a certificated aircraft is that the Designee holding the Inspection Authorization assure himself that the aircraft and its systems are sound and functionally tested to the extent that he can use his Authorization to pronounce the aircraft airworthy and release it to flight."

The Vice President and General Manager, Aircraft Division, to whom both the quality control personnel of the service department and the inspectors of the production department report, deleted the requirement for quality control of certain items which were to be inspected during the normal work accomplished by the production department. In this instance the company records do not reflect the issuance of an O & IR which is used for this work, and none was ever found. The General Inspection Supervisor for the electrical work of the production department testified that none of his inspectors was involved in the inspection of the electrical work performed on N804LJ during the modification.

The FAA-designee inspector working on N804LJ stated at the public hearing that on October 18, he certified the aircraft airworthy for test flight only. An FAA Form 337 for the major repair and alteration of aircraft was completed on the same date. The test pilot scheduled to fly the aircraft on October 19 testified that during the preflight walkaround inspection the left tip tank fuel pump was inoperative. The preflight was discontinued until this was corrected. When the aircraft was again announced as "ready", the walkaround inspection was completed but during the engine check prior to takeoff he . . . actuated the two nacelle (heat) switches and shortly thereafter smoke was observed coming from the forward bulkhead just forward of the pilot's seat . . . the warning lights illuminated and the aircraft started to pressurize. I immediately turned off all of the electrical equipment and returned to the ramp." The discrepancy was discussed with line personnel and Pilot David. The test pilot observed some wires with diagonal burn marks while mechanics were working on the annunciator panel, and assuming this was the difficulty, left the general

area. Subsequently the aircraft was again announced as ready, and without discussion of corrective action a test flight of 2:05 hours was conducted. All items relating to safety of flight were checked. At the completion of this flight there were 20 discrepancies on the aircraft. Included in this list were: "Loud howl in (forward bulkhead)" and "aircraft vibration noted above 300K - feels like aircraft not engines." He did not consider the aircraft flight testing completed. During the discussion about the flight and discrepancies, Pilot David advised the test pilot that he would fly the next flight locally. Two days later the aircraft was flown to Detroit.

The aircraft was serviced at Detroit with Aeroshell turbine fuel 640 without any additive, ^{2/} and the computed ramp gross weight was 12,534 pounds, which is less than the allowable ramp weight of 12,750 pounds. The center of gravity of 23.5 percent was within the limits of 21 to 31.5 percent.

1.7 Meteorological Information

The WB aviation area forecast for the area in which the accident occurred, valid from 1400 - 0200, was in part as follows:

Mostly ceiling 600-1,200 feet overcast variable to broken, 2,500-4,000 feet overcast visibility 4-7 miles, fog, haze, occasional visibility 2-5 miles, light rain, fog. Locally ceiling 300-500 feet obscuration, visibility 1-2 miles, light drizzle, light rain, fog. Tops generally 20,000-25,000 feet sloping down over central Illinois, central Indiana to 10,000-12,000 feet. No icing of consequence, freezing level 9,000-10,000 feet.

^{2/} Phillips Anti-icing Fuel Additive, PFA55MB, must be added to all approved fuels except JP-4, which already contains the additive.

The Jackson surface weather observation at 1900 was in part: measured ceiling 500 feet overcast, visibility 3 miles, very light drizzle, fog, temperature 50 degrees. The 1945 Detroit Metropolitan Airport radar weather observation, including the Jackson area, showed a scattered area of echoes containing light and very light rain showers, decreasing slowly in intensity. The tops of detectable moisture were at 22,000 feet m.s.l. The Chicago radar weather observation at 1942 revealed no echoes in the vicinity of Jackson. The 1900 Flint winds aloft observation was in part as follows:

<u>Height</u>	<u>Direction (True)</u>	<u>Velocity</u>
20,000 feet	200 degrees	22 knots
23,000	190	35
25,000	210	45

Moonset at Jackson was 1646.

Statements were obtained from the pilots of three flights who were in the vicinity of the accident site near the time of the accident. One aircraft departed Willow Run Airport at 1930. The pilot stated, "The ceiling just northeast of Willow Run was approximately 900 feet. During climb west-bound, several cloud layers were encountered, but by the time the flight reached a position some 40 miles west, or just north of Jackson, Michigan, at approximately 1940 e.s.t., it was on top and in the clear. Tops in the area were estimated to be 10,000-11,000 feet. No ice was detected in clouds during climbout, nor was any turbulence encountered." Another flight which was holding west of Jackson at FL 260 reported experiencing moderate chop, but was unable to recall the cloud conditions. The Cleveland ARTCC controller stated that this flight was in the same general vicinity as N804LJ when it disappeared.

Examination of the wreckage following removal from the accident site was conducted at the Reynolds Airport in Jackson, and later at the Lear Jet Facility at Wichita, Kansas.

Portions of all major parts of the structure and flight controls were found in the impact area. In most cases the heavy fittings and actuators were found completely separated from all attaching structure. Parts of both nose section access doors, and pieces of all cabin windows, the cabin door, and fragmented pieces of the windshield were all identified.

Within the impact area the horizontal stabilizer was recovered in many pieces, including the tip fairings and the center hinge and surrounding rib structure. The hinge pin had separated from the left rib and remained in the right rib with portions of vertical stabilizer attach fittings still intact. The stabilizer jackscrew was in the normal range between 0 and 0.5-degree nose-down. Portions of all the flight controls and most of the attaching hinges were identified, with no evidence of pre-impact failure. The landing gear, flaps, and spoilers were determined to have been retracted at impact.

Both aircraft engines incurred severe flattening and accordioning in the fore and aft axis. They revealed rotational scoring, but the various indices of power being developed were contradictory.

The aircraft generators both exhibited rotational scoring on the drive end. The generator leads to the electrical load center showed no arcing, heat, or fire damage. The nacelle heat relays showed very slight fire damage but no signs of operational distress. Both batteries had fire damage on the left terminals, but there was no sign of electrical arcing. Pieces of both static inverters were recovered with no evidence of fire or heat damage.

Very little of the aircraft instrument panel was recovered. Both vertical gyro indicators were displaying a straight and level flight attitude. The "Off" flag drive gear of one was in the power off position and the flag had been imprinted on the instrument face. The flag and drive gear from the other instrument had been torn loose. One Collins 331A course line indicator was found with the compass card indicating 260 degrees and the heading index impacted into the compass card between 260 and 270 degrees. One radio magnetic indicator instrument dial face was recovered with impact markings from the "T-shaped" flange and adjacent gears behind the face oriented in such a way that the face was indicating 360 degrees at the time of impact. An omni bearing indicator assembly was frozen by impact at 260 degrees. All these instruments are AC powered and retain the presentation being displayed when electrical power is removed.

1.13 Fire

Fire damage or sooting was observed on approximately 10 percent of the wreckage, but there was no evidence of pre-impact fire.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

Flight testing of the radar coverage over the crash site revealed a minimum receptor altitude of 2,100 feet m.s.l. The estimated point of target loss on radar was approximately 3/4-mile south of the crash site.

1.16 Other

AC electrical power is developed in the Lear Jet by two 115 volt, 400 cycle static inverters, each capable of delivering 250 volt-amperes. The

system is designed to have only one inverter at a time supply power. Either inverter supplies AC power to the 26 volt AC circuit and the respective primary or secondary bus; however, power to the other bus is available only through a bus tie breaker.

From the evidence and the Board's expertise it is concluded that the aircraft would be difficult to control during night operations, in turbulence, with the gyro horizon and yaw damper inoperative. The Flight Manual states that the yaw damper must be operative for all flight conditions except takeoff.

2. ANALYSIS AND CONCLUSIONS

2.1 Analysis

The crew was properly certificated and the aircraft gross weight and c.g. were within allowable limits. The aircraft was not ready for flight with passengers and was in a test status at the time of departure from Wichita.

The unique circumstances and certain management decisions pertaining to the modifications to N804LJ resulted in the aircraft being worked on by both the production and the service departments of the company. A company official signed for work which was not inspected, and deleted the requirement for other work items because they were to be accomplished by the production department. The production department, normally working with an O & IR, did not assume responsibility for the inspection of any of their work except that which was integral to the buildup of the units or wiring installed. Additionally, no O & IR was even issued in connection with the work done. Thus the aircraft arrived at the flight department without the

quality control normally afforded a production aircraft, or the inspection of all items normally provided a service aircraft. At this point the FAA-Designee Authorized Inspector and the test pilot both assumed the aircraft to be a production test aircraft, which required a much more extensive testing program than a service aircraft. The Designee released the aircraft for test flight only and the test pilot, on the third attempt, finally completed the major items of safety during a two-hour test hop, but still considered the aircraft in a test status only. It is significant that Pilot David was advised of the status of the aircraft and in fact advised the test pilot that he would fly the aircraft locally himself on the next flight. However, as a result of inadequate intra-company coordination on the work, inspection, and flight testing of the aircraft, it was improperly decided to utilize N804LJ for transportation of a company official.

Except for the reference to a possible yaw damper difficulty, the flight to Detroit and the return portion progressed normally until approximately 1933. At this time the aircraft was cruising at FL 250, presumably in the clear but experiencing moderate turbulence. The flight was proceeding on a heading of approximately 260 degrees, and in the process of switching to the newly assigned radio frequency. Before communication could be re-established the flight commenced an abnormally sharp turn to the right and disappeared from the radar scope.

At the time N804LJ disappeared from radar it was in the same general area as two flights which reported moderate turbulence. Although a third

Flight did not experience any turbulence, and one of the previous flights described light to moderate turbulence, the latter flight maintained a rough air penetration speed. Additionally the flight recorder readout from this flight revealed acceleration excursions up to 1.0-g which is the upper limit of the moderate turbulence range. Accordingly the Board concludes that N804LJ was in an area of at least moderate turbulence.

Despite the lack of any specific information from the crew regarding an explanation for the deviation from their flight plan, the evidence developed in the investigation permits a reasonable analysis of the circumstances surrounding the final maneuver.

The Board, in attempting to correlate the indications of the AC powered instruments with the final maneuver, concludes that the crew experienced an AC electrical failure and resultant loss of both primary attitude and heading references as well as the yaw damper, while flying on the assigned route. The pilots, faced with the extremely difficult task of controlling the aircraft under these circumstances during night, turbulent conditions, lost control of the aircraft and an upset occurred. The aircraft disappearance from radar very shortly after the deviation, and the impact attitude, indicate that the upset involved a very steep spiral. It is possible that total AC and DC electrical failure occurred during the descent, thereby resulting in the loss of radar reception of the transponder. However, it is believed more likely that the proximity of the last target to the crash site, and the inability of the controller to detect a primary return from the aircraft within seconds of the secondary target loss, indicates that the loss of radar

contact resulted from the aircraft's descent below the minimum radar reception altitude of 2,100 feet.

The severe degree of aircraft disintegration precluded a determination of the exact source of the electrical difficulty. However, the AC electrical system is essentially a single bus concept, since the primary and secondary busses are wired together in series through the bus tie breaker. This permits a short in any AC component to fail both the main inverter and then the standby inverter as it in turn is selected. Such an electrical problem and subsequent attempt to rectify the problem is indicated in the 360-degree heading displayed on the RMI. The heading conforms to neither the 260-degree heading of the other instruments nor the 335-degree heading at impact, and is probably the result of some combination of bus and circuit breaker isolation during troubleshooting, or a partial restoration of power prior to the final AC power failure in the final maneuver.

2.2 Conclusions

(a) Findings

1. The crew was properly certificated.
2. The aircraft was properly certificated, and had been released for test flight only.
3. There were inadequacies in quality control, inspection, and flight testing during the major modifications of the aircraft.
4. The gross weight and center of gravity were within allowable limits.
5. There was turbulence at the flight's cruising altitude.

6. Under night, turbulent conditions, the flight experienced AC electrical failure.
7. There was a loss of control of the aircraft due to inadequate attitude reference.
8. The specific cause of the AC electrical failure is unknown.

(b) Probable Cause

The Board determines that the probable cause of this accident was a loss of adequate attitude reference resulting from AC electrical power failure under night, turbulent conditions.

3. RECOMMENDATIONS

The Board believes that various modifications which have been accomplished in the instrumentation and electrical systems of the Lear Jet since this accident negate the requirement for additional recommendations at this time. Among the improvements was the installation of an attitude indicator powered by a source separate from the aircraft primary electrical system.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD:

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Chairman

/s/ OSCAR M. LAUREL
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