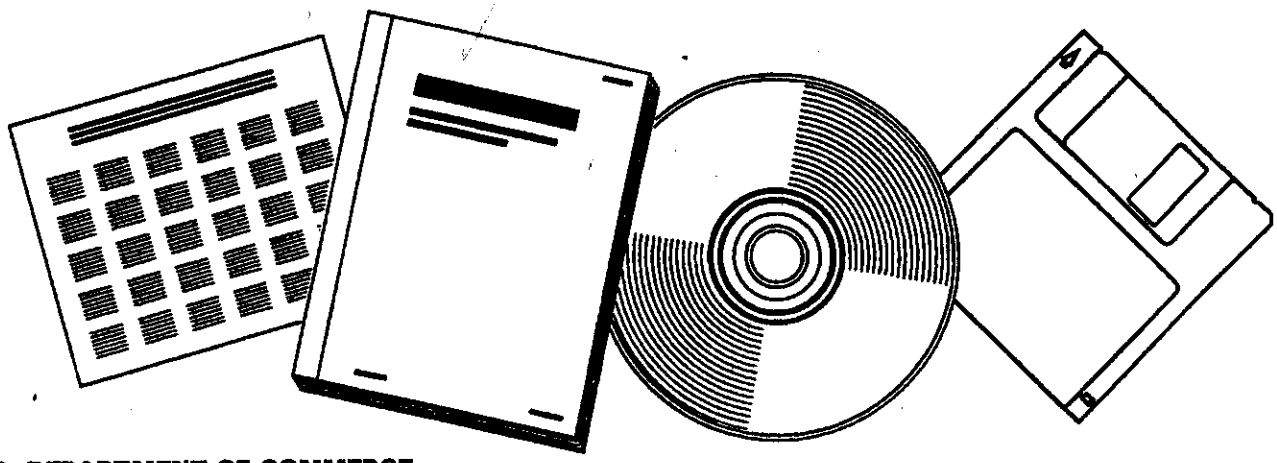
AIRCRAFT ACCIDENT REPORT. REXALL DRUG AND CHEMICAL COMPANY. LEAR JET 23, N235R. CLARENDON, TEXAS

NATIONAL TRANSPORTATION SAFETY BOARD,
WASHINGTON, D.C

23 APR 1966



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

SA–None

File 2–1179

AIRCRAFT ACCIDENT REPORT

Adopted: December 19, 1967

REXALL DRUG AND CHEMICAL COMPANY

LEAR JET 23, N235R

Clarendon, Texas

April 23, 1966

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

RESEARCH AND DEVELOPMENT REPORT ABSTRACT AND EVALUATION

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION
BUREAU OF PUBLIC ROADS

DATE EVALUATED: November 10, 1970

1. STATE	2. STATE'S STUDY NO.	3. BPR ADMIN. IDENT NO.
Florida	B-1-63	2370

4. STUDY TITLE
Research on Asphaltic Materials

5. REPORT TITLE	6. AUTHOR(S)
Research on Asphaltic Materials--Terminal Report	H. E. Schweyer, Principal Investigator J. C. Busot, Co-Principal Investigator
7. R&D DIVISION TO WHICH ASSIGNED: Materials	8. PROGRAM AREA: 4671-052

9. STUDY CONDUCTED BY
University of Florida

10. SPONSORING AGENCY:
Florida Department of Transportation

11. TYPE OF R&D:
☐ THEORETICAL ☒ APPLIED ☐ DEVELOPMENT ☐ MT&E ☐ OTHER R&D

12. STUDY STATUS
☐ ACTIVE ☒ COMPLETE — 6 YEAR OF A 6 YEAR STUDY

13. ABSTRACT ORIGINAL BY: Authors (EDITED) BY: J. M. Rice

This terminal report includes summaries of reports submitted during the course of a 6-year laboratory study of selected asphalt cements. Also included is an updating of basic rheological and compositional information on several asphalts and a rheological evaluation developed using an Instron extrusion technique. Rheological responses were studied by a computerized cluster analysis technique. This analysis was extended to durability responses using the Thin Film Oven Test and a special Weatherometer test. The cluster technique enables classification of asphalts in groups with similar responses. Identification of these groups with levels of performance could possibly be of value for specification purposes.

Other contributions made during the course of the study were: (1) creep test data on asphalts at low temperatures for evaluation of viscoelastic behavior, and the preliminary development of a compression test for rheological tests over a wide range of temperatures; (2) comparative data of rheological responses in the sliding plate, cone-and-plate, and extrusion rheometer providing information about the relative merits of these instruments which deform asphalt in different geometries; (3) new procedure for compositional analysis and chemical evaluation of components; (4) Weatherometer procedure for use in conjunction with the Thin Film Oven Test for the study of the response of asphalts to a durability test environment; and (5) a total of seven publications.

14. STATE HOW THE RESULTS OF THIS RESEARCH CAN BE USED OR APPLIED. The findings of the study are primarily of interest to researchers involved in studies associated with rheology, durability, and composition of asphalt cements. The applicability of the findings to the behavior of asphalt in pavements still has to be ascertained prior to any specification /formulation.

15. COMMENTS:
None

TECHNICAL COORDINATOR	DIVISION, REGION OR R&D DIVISION

REXALL DRUG AND CHEMICAL COMPANY
LEAR JET 23, N235R
CLARENDON, TEXAS
APRIL 23, 1966

TABLE OF CONTENTS

File No. 2-1179

NATIONAL TRANSPORTATION SAFETY BOARD
DEPARTMENT OF TRANSPORTATION
AIRCRAFT ACCIDENT REPORT

Adopted: December 19, 1967

REXALL DRUG AND CHEMICAL COMPANY
LEAR JET 23, N235R
CLARENDON, TEXAS
APRIL 23, 1966

SYNOPSIS

A Rexall Drug and Chemical Company Lear Jet, N235R, crashed approximately 1.5 miles southwest of Clarendon, Texas, at about 1238 on April 23, 1966. Both of the crewmembers were fatally injured. There were no passengers. The aircraft was destroyed.

The flight, for the purpose of issuing a type rating to the pilot, was returning to Fort Worth from Amarillo, Texas. During an unrestricted climb to Flight Level 410, there were numerous routine communications between various air traffic control facilities and the flight. The last intelligible transmission was an acknowledgement of instructions to change radio frequencies, at approximately 1234. About 54 seconds later an open microphone carrier tone, lasting 15.5 seconds, was received from the aircraft. At 1235:40 the radar target from the aircraft disappeared. The weather existing at the time of the accident included cirrus clouds and moderate to severe turbulence associated with a jet stream with wind velocities in excess of 75 knots.

The Board determines that the probable cause of this accident was the loss of control of the aircraft, in turbulent, instrument conditions, which could have been caused by a failure of both gyro horizons. ( )

1. INVESTIGATION

1.1 History of the Flight

A Rexall Drug and Chemical Company Lear Jet, N235R, arrived at Amarillo, Texas, at 1112 [1/] on April 23, 1966. There were no reported discrepancies with the aircraft. The pilot and the Federal Aviation Agency (FAA) Operations Inspector, who was giving the pilot a flight check for a type rating, proceeded to the Flight Service Station (FSS) where a weather briefing was received. An Instrument Flight Rules (IFR) flight plan was filed to Fort Worth, Texas, via selected airways to Bridgeport, Texas, and then direct to the Fort Worth outer marker. The estimated time en route was 45 minutes, with a true airspeed of 440 knots at Flight Level 410 (FL 410). During the taxi-out the flight was issued a clearance as filed.

At 1226 the flight departed on Runway 3, with instructions to maintain runway heading for a vector to J-58, the initial airway. At 1231:30, the flight was 21 miles east of the Amarillo VORTAC, and control of the flight was transferred to Albuquerque Air Route Traffic Control Center (ARTCC). Ten seconds later they reported leaving FL 240. At approximately 1234 a radar hand-off was effected 38 miles from the Amarillo VORTAC, and the flight acknowledged the new frequency for the Fort Worth Center. At 1234:54 an open microphone sound began on the Albuquerque frequency and lasted 15.5 seconds.

The Fort Worth Center controller who had assumed control responsibility for the flight was observing the progress of the aircraft radar target along J-58, while awaiting the initial radio contact from the flight. At 1235:40 the secondary radar (beacon) target from N235R disappeared. The controller instantly

---

1/ All times herein are central standard, based on the 24-hour clock.

turned up the primary radar gain in order to locate the aircraft "skin paint" but no target was observed. Radar contact was lost about nine miles east of the impact site. A flight check revealed that the minimum altitude for both primary and secondary radar coverage in this area is 20,000 feet.

The aircraft crashed 1.5 miles southwest of Clarendon, Texas, at approximately 1238, during daylight. The geographic coordinates are 34°55'6" N. latitude and 100°54'13" W. longitude, and the elevation at the crash site is 2,820 feet m.s.l.

Witnesses in the area reported hearing the aircraft making a loud, shrill, noise before they observed it. Some also heard one or two booms which they associated with a sonic boom. They generally agreed that the sky was overcast, and reported good visibility although it was raining. Witness observations of the aircraft were inconsistent and no meaningful flightpath was established from this source.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
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

Pilot William M. Majowski, age 28, held airline transport pilot certificate No. 1433989 with a rating for airplane multi-engine land and commercial privileges

in airplane single engine land. His FAA first-class medical certificate was issued February 11, 1966, with no limitations. He was hired by the Rexall Drug and Chemical Company on June 7, 1965. Company records indicate that he had accumulated 2,554 total flying hours of which 380 hours were in the Lear Jet.

Operations Inspector James D. Sweep, age 45, held airline transport pilot certificate No. 385428 with ratings in the DC-3 and Lear Jet Model 23, and commercial privileges for airplane single engine land and sea, and flight instructor. His FAA first-class medical certificate was issued April 18, 1966, with the limitation that, "Holder shall possess corrective glasses for near vision while exercising the privileges of his airman's certificate." He was employed by the FAA in July, 1961, and had accumulated 8,387 total flying hours of which 529 hours were in jet aircraft and 48 hours were in the Lear Jet. He attended ground school at the Lear Jet facility in Wichita, Kansas, received flight training from Executive Jet Airways, Inc., Columbus, Ohio, and was issued a type rating in the Lear Jet Model 23 on May 28, 1965. He was conducting his tenth type rating check at the time of the accident. Statements obtained from the previous applicants he had checked indicate that all flights were conducted in accordance with established procedures.

1.6 Aircraft Information

N235R, a Lear Jet Model 23, serial number 23-032, was manufactured on June 24, 1965, and at the time of the accident had accumulated a total of 436.7 hours. It was maintained in accordance with FAA requirements. The last 100-hour inspection was completed April 20, 1966.

The aircraft was equipped with two General Electric Model CJ-610-4 engines installed as follows:

Position	Serial No.	Total Time
1	241006	436.7
2	241003	436.7

The aircraft was serviced with A/50 type jet fuel and anti-icing additive. The approximate gross weight at takeoff was 11,668 pounds, well below the allowable of 12,500 pounds. The center of gravity was at 25.0 percent, which is within the allowable limits of 16 - 31.5 percent.

1.7 Meteorological Information

The Weather Bureau (WB) aviation area forecast prepared at Fort Worth, valid for the 12-hour period beginning at 0700 was in part as follows:

> Weak, nearly stationary, front near Fort Smith-Waco line westward will move little during day. Widely scattered thunderstorms developing northwestern Texas during early morning, will spread into central Oklahoma by 1900. North and west of front generally ceilings 300-600 overcast, 1-3 miles light drizzle, fog, locally ceiling zero, sky obscured, light drizzle and fog. Variable layers to 20,000 feet. Cumulonimbus tops to 45,000 feet. Conditions improving by late morning to ceiling 800-1,500 feet overcast, 2-5 miles, fog, occasional light drizzle with scattered thunderstorms, light rain showers.
>
> Moderate, locally heavy, icing in cumulonimbus and occasional moderate rime icing in clouds elsewhere above freezing level 11,000-12,000 feet. Severe turbulence all levels near thunderstorms.

The 0600 chart for the 300 mb. level (approximately 30,000 feet) showed a broad southwesterly flow of air over the Southern Plains and a double jet stream structure. One jet stream was shown extending, in part, from southwestern New Mexico northeastward to southwestern Minnesota, and the other extended from extreme southeastern New Mexico to just east of Amarillo, thence northeastward through the accident area. The winds associated with both streams were in excess of 75 knots. The 1200 winds aloft observation at Amarillo was, in part, as follows:

Height (m.s.l.)	Direction (True)	Velocity
25,000 feet	220 degrees	43 knots
30,000	210	58
32,000	200	77
35,000	180	73
38,000	180	81
40,000	200	65

At the time of the accident WB criteria for forecasting severe turbulence included vertical wind shear in excess of 6 knots per 1,000 feet and horizontal shear greater than 40 knots per 150 miles in association with a jet stream.

The 1245 observation on the Amarillo WSR-57 weather radar showed that the accident site was in a broken area of echoes from light rain showers reaching the surface, and thunderstorms with light rain showers reaching the surface. The tops of detectable moisture were from 15,000-20,000 feet.

The 1242 special surface weather observation at Amarillo, 40 miles northwest of the accident, was:

Estimated 8,000 feet broken, high overcast, 10 miles, light rain, wind 120 degrees, 9 knots, altimeter setting 30.11, few scud east.

The 1239 special surface observation at Childress AFB, 42 miles southeast of the accident was:

> Balloon ceiling 900 feet overcast, 3 miles, thunderstorm, light rain showers, fog, altimeter setting 30.07, pressure falling rapidly.

The freezing level at Amarillo was 11,000 feet.

Pilots flying in the general area at the time of the accident reported turbulence and IFR conditions above FL 310. Additionally, weather satellite photographs of the general area, taken within one hour of the accident, revealed dense cirrus clouds of the type frequently associated with jet streams. These clouds, the conditions described above, and other meteorological data satisfy the necessary criteria, as determined by meteorological research associated with high altitude turbulence, to clearly indicate that turbulence of at least moderate intensity existed above the 30,000-foot level.

1.8 Aids to Navigation

There were no reported discrepancies with any of the navigational aids.

1.9 Communications

All communications between the flight and the air traffic control facilities were routine. The open microphone sound, recorded on the Albuquerque center frequency, was analyzed by the Federal Bureau of Investigation. They reported that the sound level increases in excess of three volume units from beginning to end, and ". . . contains the same general noise distribution as the known transmissions from N235R . . ." and different from the sounds of transmissions from other aircraft recorded on the tape.

1.10 Aerodrome and Ground Facilities

Not applicable.

1.11 Flight Recorders

The aircraft was not required to have flight recorders and none were installed.

1.12 Wreckage

The aircraft crashed in gently rolling terrain of relatively soft sandy soil up to two feet deep, with an underlying hard packed crust. The impact left three distinct craters which were interconnected by a narrow scar and aligned on a bearing of 030-210 degrees. Parts of the aircraft were found approximately nine feet deep in the center crater. The bulk of the wreckage was thrown out in a fan shape with a centerline of 210 degrees. The north and south craters contained parts of the left and right wing tip tanks respectively, and the center crater contained many heavy components from the fuselage. Despite the extensive breakup, parts of all major portions of the structure and control surfaces were found at the site.

The nose section of the fuselage disintegrated. The largest pieces of pressurized section were a 40-inch length of cabin door surround structure and a crushed mass of keel beam attach fittings, fuselage fuel cell material, and control cables and pulleys. The tail cone was represented largely by three pieces of skin and stringers ranging from four to six feet in length.

Plastic material from the windshield and windows was recovered from the center crater. No piece had a maximum dimension of over four inches, and most pieces were delaminated or pulverized. The complete upper and

lower cabin door hinges were found attached to portions of the cabin or door structure.

The wings were generally found as small pieces of upper and lower skin, separated access plates, short sections of spar caps and webs, and heavy fittings. The largest piece of wing was a four by five-foot section of the left wing skin.

The horizontal stabilizer separated into twisted pieces of spar cap, relatively large pieces of interspar skin panels, and individual fittings. The left boss of the stabilizer hinge forging failed and the hinge pin had separated from the right boss. The failed parts of the stabilizer attach and hinge fittings were examined carefully. All fractures, cracks, brinelling, etc. appeared to be typical of failure resulting from gross overloads. There was no evidence of any repeated impact on the stabilizer structural up-and-down stops.

The recovery and identification of parts of the control surfaces varied from 70-100 percent, except the ailerons which were too mangled to estimate.

Almost the entire spanwise length of both elevators was identified. The left elevator was in four pieces ranging in length from nine inches at the tip to 30 inches at the inboard end. The right elevator was in two main pieces, one 73 inches long and another nine inches long. Four of the five elevator hinge brackets and part of the fifth were identified. These were separated from the surrounding structure. The bearing in one outboard bracket turned freely, but the others were missing or damaged. The elevator and rudder counterweights were never identified although one small piece of

lead was found which was not associated with the aileron weights. The trailing edge strips which are glued to all primary control surfaces separated, and little of this material was found.

The horizontal stabilizer jackscrew was less than one-half turn from the full aircraft nosedown stop, which is the normal range. The aileron and rudder electric trim actuators were compared with undamaged units, and each was found to be in a near neutral position.

The spoiler actuators were fully retracted, which is the spoilers down position. The wing flap actuator was torn from its attach points. The landing gear actuators for the left main gear and nose gear were in the gear up position. The right main gear actuator was in the midpoint position.

The rotating components of both powerplants disclosed moderate to heavy rotational damage. None of the bearings examined exhibited evidence of operational distress, nor was any evidence of fire or operation at elevated temperatures found.

Both starter-generators were recovered and exhibited similar rotational damage to the rotor housings. The two batteries were heavily damaged, but the quick disconnect fittings were still attached to the battery posts. The two static inverters were destroyed by impact. However, the eight P/N 2359 transistors were examined for evidence of overheat conditions such as would cause the inverters to program off the line. Six of the eight transistors were still operational, but the other two were impact damaged. None showed any sign of an overheat condition. A standby rotary inverter was examined and showed no evidence of rotational scoring.

Only one gyro horizon, unidentifiable as to side, was recovered. This attitude indicator revealed impact damage compatible with a presentation of five degrees noseup and ten degrees left wing down. The "power off" warning flag for this instrument is spring loaded to the "power off" position and was impact-formed in this position.

The two VOR receivers indicated bearings of 118 degrees and 288 degrees, but no determination of "To" or "From" signals could be made. A course line indicator was recovered and determined to be indicating an aircraft heading of 180 degrees.

The rotary-type vertisyn and directisyn source selection switches were found in the primary position. These switches allow the pilot to select the secondary or copilot's gyro or directional information to be displayed on his instruments if the primary system is inoperative.

1.13 Fire

There was no evidence of fire on any part of the aircraft or on the ground in the impact area.

1.14 Survival Aspects

This was a nonsurvivable accident.

1.15 Tests and Research

A review of the flutter substantiation disclosed that it was based on ground vibration tests and analysis. The aircraft was calculated to be free of flutter to speeds in excess of 1.2 V_D/M_D [2/] (400 knots to 20,500 feet and 0.90 Mach above). Flight flutter tests had been conducted to 386

2/ V_D/M_D refers to the design dive speed or Mach number for the particular regime of flight.

knots and 0.86 Mach. Static balance of the elevator was provided by weights in the tip overhang. Production balance limits of 0 to 0.5 inch-pounds nose heavy on each elevator had been established. The flutter speed was highly sensitive to, and rapidly reduced by, increasing amounts of under-balance (tail heavy).

A questionnaire regarding the operational experience of the electrical/instrument system of the Lear Jet was circulated to 73 owner/operators. Fifty-two responses were received. Fifty percent indicated they had experienced gyro horizon failures or malfunctions, but only six operators attributed the failures to AC power loss. Several commented further that these AC power losses were subsequently found to have been caused by malfunctions in either the vertisyn or directisyn systems. Additionally, 38 percent reported inverter failures. Only four of the 26 operators reporting gyro failures had accumulated over 1,000 hours on their aircraft. The average service life experience by these operators, for various components, is as follows:

Vertisyn	-	318 hours
Directisyn	-	325 hours
Static Inverter	-	391 hours

1.16 Other

AC electrical power is normally 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. In addition, N235R had a rotary inverter installed as a standby source of AC power.

From the evidence it is concluded that the Lear Jet, like most high performance swept-wing aircraft, has low inherent lateral directional stability. Accordingly, the aircraft would be difficult to control during operation in turbulent, instrument conditions 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

There was no evidence of inflight powerplant or flight control malfunction. Portions of all control surfaces in the impact area and the lack of hammering on the stabilizer up and down stops indicate that no flutter was encountered.

The flight departed normally, entered a broken to overcast cloud deck at approximately 10,000 feet, and was probably in clouds throughout the remainder of the flight.

Since there was no climb restriction imposed, the normal en route climb performance of the aircraft would have placed the flight at approximately FL 330 by 1234. At this time they acknowledged a radio frequency change from the Albuquerque to the Fort Worth Center. Although this transmission was normal, the flight was well above the 30,000-foot altitude at which they

would have entered the moderate to severe wind shear turbulence associated with the jet stream. The 15.5-second open microphone carrier signal from N235R was recorded at 1234:54 on the Albuquerque frequency, indicating a disruption of normal cockpit duties shortly after 1234, and before the frequency change was accomplished. Although there was no voice transmission during the carrier signal certain meaningful information was derived. The increase in sound level indicates not only the availability of DC power during the upset, but also the rapid buildup of airspeed at this critical time. The crew's preoccupation with the emergency and subsequent loss of control is evident in that they never accomplished the change to the newly assigned frequency.

The Board concludes that there was a loss of control of the aircraft which could have been caused by the failure of both gyro horizons during turbulence. While only one was recovered, if the other had not also failed, a cross-check of other instruments would have quickly identified the remaining operative gyro horizon and the upset should not have occurred. An unsatisfactory trend of in-service failures of the Lear vertisyn package is amply demonstrated in the questionnaire survey of operators. Attempting to control the aircraft by means of secondary attitude reference under turbulent, instrument conditions is an extremely difficult task in this aircraft. The gyro horizon failures may have resulted from an AC power failure; however, the rotary-type vertisyn and directisyn selector switches were in the primary position, and the third inverter was not rotating at impact. This does not preclude the possibility of progressive electrical difficulty resulting

in eventual total AC power loss. On the contrary, the 180-degree heading on the AC-powered course line indicator tends to confirm such an emergency. This heading is incompatible with either the last established airway or the impact heading. Apparently AC power was available to the compass after the gyro horizons had failed and the aircraft was upset, but was interrupted prior to impact. Additionally, several operators have reported that AC electrical failures were caused by malfunctions in the vertisyn or directisyn systems.

2.2 Conclusions

(a) Findings

1. The aircraft was airworthy and the crew properly certificated for the flight.
2. The gross weight and c.g. were within allowable limits.
3. The crew experienced a loss of primary attitude reference (both gyro horizons).
4. An upset occurred as a result of inadequate attitude reference while flying under instrument flight conditions in turbulence.
5. The Board is unable to establish the source of the electrical difficulty.

(b) Probable Cause

The Board determines that the probable cause of this accident was the loss of control of the aircraft, in turbulent, instrument conditions, which could have been caused by a failure of both gyro horizons.

3. RECOMMENDATIONS

The Board believes that various modifications which have been accomplished in the instrumentation and electrical systems of the aircraft 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.

JOSEPH J. O'CONNELL, JR.
Chairman

OSCAR M. LAUREL
Member

JOHN H. REED
Member

LOUIS M. THAYER
Member

FRANCIS H. McADAMS
Member

5060