AVIATION OCCURRENCE REPORT

COLLISION WITH LEVEL TERRAIN

CHRYSLER AVIATION INC.
LEARJET CORPORATION L36A N14TX
STEPHENVILLE, NEWFOUNDLAND
06 DECEMBER 1996

REPORT NUMBER A96A0207

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Summary

Learjet L36A (serial number 033), N14TX, was on an instrument flight rules (IFR) flight from Grand Rapids, Michigan, to Stephenville, Newfoundland. At 0216 Newfoundland standard time (NST1), N14TX was cleared by Gander Area Control Centre (ACC) for an approach to the Stephenville airport. The co-pilot contacted the St. John's Flight Service Station (FSS) and advised that they would be conducting an approach to runway 28. The FSS specialist relayed the latest Stephenville weather observation and runway surface condition report to the aircraft and requested that the crew advise St. John's FSS when they had landed.

When the crew of N14TX did not report after landing at Stephenville, the St. John's FSS specialist advised Gander ACC that the aircraft was missing, and a search was begun. Initial information received by the agencies searching for the missing aircraft did not include the aircraft's last recorded radar position. The wreckage was located approximately three hours and ten minutes after the aircraft was reported missing, within the airport perimeter, close to the last observed aircraft radar position. The aircraft struck a service road embankment in an inverted, wings-level attitude. The two crew members were fatally injured. The accident occurred during the hours of darkness at approximately 0238 NST.

Ce rapport est également disponible en français.

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[1] All times are NST (Coordinated Universal Time [UTC] minus 3 ½ hours) unless otherwise noted.

Other Factual Information

Both the pilot and co-pilot were highly regarded by company management personnel. A review of the flight crew's pilot records indicated that they were certified and qualified for the flight in accordance with existing regulations. The pilot had worked for the company for several years and had about 5,700 hours total flight time, with 3,000 hours on Learjets. He was also a multi-engine aircraft instructor and a licensed airframe and power plant mechanic (A&P). The co-pilot had about 2,800 hours total flight time, with 400 hours on Learjets, and was also a multi-engine aircraft instructor. Both crew members had landed at the Stephenville airport on prior occasions.

The 0230 NST Stephenville weather, passed to the crew of N14TX by the St. John's FSS specialist, was as follows: wind 040 degrees magnetic at 17 knots; visibility 12 miles in light snow and drifting snow; ceiling 4,000 feet overcast; temperature 1°C, dew point -3°C; and altimeter setting 29.75. The wind information was taken from the latest Stephenville weather observation (0230 NST), as the St. John's FSS specialist does not have the actual Stephenville wind direction and speed. The winds reported to the crew would yield a tailwind component of 10 knots; the aircraft's operational maximum tailwind component limit for landing is 10 knots. After the accident, the Stephenville wind velocity was determined from the surface wind recording (chart). When N14TX approached the threshold to runway 28, the recorded wind direction and speed was 040 degrees magnetic at 20 knots with gusts to 22 knots, giving a tailwind component of about 12 knots. During certification tests, adequate control of the aircraft was demonstrated during landing and take-off in crosswinds up to 24.7 knots. The runway surface condition at 2212 NST was as follows: a 180-foot centre line was 60 per cent bare/dry, 20 per cent compacted snow, 20 per cent light snow 1/8-inch deep, with a windrow on the north side, 10 feet inside the edge lights and 2 ½ to 3 feet in depth. The James Brake Index (JBI), with a temperature of -1°C, was reported to be 0.42.

The aircraft was equipped with a cockpit voice recorder (CVR), although it was not required by Federal Aviation Regulations (FAR) for this flight. The recorder was recovered and sent to the TSB Engineering Branch for analysis. For undetermined reasons, the CVR cockpit area microphone channel was not being recorded; therefore, no flight crew conversations were available to investigators. The CVR recording did provide other information relative to the flight, such as landing gear warnings, autopilot disconnect, keying of the microphone(s), radio transmissions, and ignition on selection. The aircraft was not equipped with a flight data recorder (FDR) nor was one required by regulation.

Runway 28 at the Stephenville airport is 10,000 feet long by 200 feet wide. The approach to the ILS runway 28 has a non-standard 4.5° glide path angle and the runway has a 0.69% downslope. An aircraft radio control aerodrome lighting (ARCAL) system controls the centre row approach lights, threshold lights, and runway edge lights. The pilot's setting of the lights was determined by counting the microphone clicks on the CVR recording. The ARCAL system was activated to medium setting when the aircraft was established on the approach 8.4 nm from

the threshold and about 3,200 feet above sea level (asl). The pilot selected the low setting at 7.3 nm and then reselected the medium setting when the aircraft was 6.6 nm from the threshold. An analysis of the recorded Gander ACC radar data showed that the aircraft flew the complete approach for the instrument landing system (ILS) approach on runway 28, tracked the localizer correcting for the crosswind, and then deviated to the left of the runway after crossing the runway threshold. It was determined from the CVR tape that the autopilot was selected OFF while the aircraft was on the procedure turn.

Field examination of the aircraft wreckage identified that the aircraft flaps were extended to 20° at impact. The horizontal stabilizer was trimmed to an aircraft nose-up position that was consistent with a normal trim position for landing. The aileron and elevator trim tabs were in the neutral positions, spoilers were stowed, and the landing gear was retracted. The engine thrust reversers were also in the stowed position. All major aircraft components were identified at the wreckage site, and no mechanical malfunction was identified.

Nothing was found to indicate that the aircraft touched down on the runway. Runway sweeping operations re-commenced at 03:20 NST in preparation for the next scheduled arrivals, therefore, any touchdown marks that may have been present on the runway were removed. The first landing indication was a ground scar made by the left main wheel beginning in the snow at the left edge of runway 28, about 1,750 feet beyond the runway threshold, and extending for 400 feet on a heading of about 261° magnetic. This was a light impression leaving a shallow ground scar; there was no impression made by the right main wheel. Analysis of the mark and aircraft configuration showed that the aircraft was banked left about 10° when the impression was made. A second mark, about 200 feet long, started 3,650 feet beyond the threshold and 330 feet from the left edge of the runway. Examination of this scar and the aircraft's left tip-tank fin revealed that the scar had been produced by the fin when the aircraft was in a left-banked attitude of between 40° and 45° and pitched up about 12° to 14°. The left tip-tank struck the ground a second time about 4,200 feet from the threshold, with the aircraft banked about 10° to the left. Because of the absence of any wheel marks, it was concluded that the landing gear was retracted. When the tip-tank struck the ground, the left aileron was deflected nearly full down, and it was trapped in this position when the wing buckled from the impact. The aircraft rolled to the right after striking the ground, then went through a small stand of alders at 4,400 feet; the tree breaks and witness marks on the aircraft indicated that the aircraft was in a shallow right bank with the landing gear up. The aircraft continued to roll to the right and crashed in an inverted, wings-level attitude 5,080 feet from the runway threshold near the centre of the airport, just east of the intersection of runways 28 and 20. The average direction of flight of the aircraft as evidenced by the ground marks was about 261°.

Engine instruments, flight instruments, indicator lights, and other aircraft cockpit components were removed from the site and sent to the TSB Engineering Branch for further examination. Instrument analysis revealed some instrument indications, marks, or settings as follows: (left/right) fan 86.5/75%; turbine 92.6/91%; inter-stage turbine temperature (ITT) 731/866°C; indicated airspeed 120/122 knots; compass rose 260°; digital course display 275°; heading index

bug 285°; course arrow 275°; airspeed bug 133 (V_{REF}); and set altitude 3,100 feet. The flight director NAV ENG (green) light was on, the GS ENG (green) light was possibly on, and the go-around indicator light was not illuminated.

Teardown and analysis of the engines was carried out at the Allied Signal engine manufacturer's facility in Phoenix, Arizona, and was witnessed by a USA Federal Aviation Administration aviation safety inspector on behalf of the TSB. Foreign object damage (FOD) to the fans and compressor blades on both engines was consistent with fan rotation during impact. The extent of debris distributed throughout the gas path of both engines and the presence of metal spray deposits in the power turbine section confirmed that both engines were operating at impact.

Climb performance for the Learjet L36A was examined in consultation with the operator, the manufacturer, and other Learjet L36A pilots. In addition, investigators conducted trials in a Learjet L36A simulator under conditions similar to those that existed in Stephenville at the time of the accident. It was found that the Learjet L36A has more than adequate power to successfully perform a missed approach procedure under all possible combinations of aircraft configuration, provided the proper climb attitude is established and maintained. The Flight Safety International (flight training organization) procedure for a go-around/balked landing is for the pilot flying (PF) to call "going around flaps 20", simultaneously disengage the autopilot by selecting flight director go-around mode, establish a 9° nose-up attitude on the flight director V-bars, set power as required, and check that the spoilers are retracted. The pilot not flying (PNF) sets or confirms that the flaps are at 20, and calls out the direction of turn, if required, and the missed approach heading and altitude.

Based on known weights of the aircraft, crew, and cargo, and estimating the amount of fuel on board, it was calculated that the aircraft weighed about 15,300 pounds at the time of landing, which is the aircraft's maximum allowable landing weight. Take-off power is used in the go-around procedure. For the conditions at the time of the accident, take-off power would have been about 93% fan rpm. The indicated fan rpm at impact was somewhat lower; however, it is not possible to determine what power was set for the go-around. The stall speed at 15,000 pounds, with flaps 20°, in level flight, would have been about 107 knots indicated airspeed (KIAS). From the weight of the aircraft, V_{REF} for the approach was calculated to be 127 KIAS. The V_{REF} set by the flight crew was 133 KIAS, which was appropriate considering the gusty wind conditions.

It was concluded that icing, either airframe or engine, did not play a part in this occurrence. There was no freezing precipitation at the surface, there was no icing in cloud (as reported by another pilot flying in the area at the time), and there was no indication, either verbally or from analysis of the radar tapes, that the pilot was experiencing control difficulties.

It is not known with certainty why the pilot elected to land on runway 28 with a tailwind rather than land straight-in on runway 10 with a headwind. The pilot apparently discussed the landing runway prior to departing Grand Rapids and decided at that time to land on runway

28. The approach to runway 10 is over water; therefore, there are no lights under the approach path, and there is no precision approach to runway 10, whereas runway 28 is served by an ILS.

The Gander ACC was equipped with RADEX (radar data examination), a computer program that can be used to display recorded radar data. In addition to examining files of pre-recorded radar data, RADEX can also display live radar data. A computer at the Technical Duty Manager's station in the Gander ACC operations room displays and records the live radar data. The RADEX program on this computer can be used to obtain, within minutes, a missing aircraft's last recorded radar position. RADEX was developed as a test tool for the Technical Services Branch, and its full capabilities were not known to the operational management staff who had not received training or user manuals for RADEX.

The aircraft's was equipped with an emergency locator transmitter (ELT); however, it did not activate at impact. Analysis of the ELT identified that the batteries were overdue for replacement and that they were the incorrect type for operations in an environment where the temperature goes below 20° Fahrenheit. Although according to FAR 91.207 an ELT is not required equipment on a US-registered, turbojet-powered aircraft, the installation and serviceability of an ELT can provide greater safety potential by reducing the response time to locate a downed aircraft.

Analysis

There was nothing found during the investigation to indicate that the aircraft suffered any mechanical malfunction prior to the crash. Based on the instrument analysis, the engine teardown results, the aircraft's speed during the approach and excursion over the ground, and the distance the aircraft travelled after the first impact, it was concluded that the engines were operating normally and were producing high power at the time of impact.

The weather was good at the time of the approach, in that the ceiling was 4,000 feet above ground level (agl) and the visibility was 12 miles, and the crew flew a normal, uncomplicated ILS approach. In such conditions, the crew should have been able to successfully land the aircraft. The only apparent conditions that may have affected the final stages of the flight were the darkness and the drifting snow from the right tailwind. Radar and instrument indications show that the aircraft was set up for the ILS, and that the flight director system was engaged in the approach mode, although there is uncertainty as to whether the glide slope was engaged. The crew did not advise ATC of any problems with the aircraft; had they not been satisfied that they could make a safe landing, the crew would have commenced a missed approach procedure as the aircraft approached the runway. The pilot's adjustments of the ARCAL light system on final approach indicate that at least one of the pilots could see the runway lights, from about 3,000 feet agl and 6.6 miles from the threshold, and was adjusting their intensity.

Analysis of the recorded radar data indicates that the aircraft, while on the approach, remained established on the localizer, correcting for the right quartering tailwind. The heading bug selection, 10° to the right of the inbound course, also indicates a correction for the wind. When

the aircraft approached the runway threshold, its landing lights would have illuminated the drifting snow and the snow covering much of the runway surface, probably making it difficult to distinguish the runway's white centre line and, perhaps, the runway edge lights. The illuminated snow drifting across the runway at a 45° angle from behind the aircraft would give a pilot the illusion of lateral aircraft motion. Considering that there was no mechanical or aerodynamic explanation for a directional control problem, it is most likely that a flight control input, or lack of input, allowed the aircraft to drift to the left. This could have been the result of the pilot wanting to remain clear of the windrow on the right side of the runway, or his removal of the 10° crosswind correction in preparation for landing. The pilot's reference to the runway edge lights may have been degraded by the drifting snow, and when the aircraft began to drift to the left, in the same direction as the drifting snow, it could have been difficult for the pilot to detect and correct the aircraft's movement.

Touching down in the snow off the left side of the runway would have surprised the pilot and would have affected his subsequent performance in the missed approach. Heading left off the runway, in the dark and with a lack of ground lights in that direction, the pilot had a limited horizon comprised of the snow surface illuminated by the aircraft's landing lights, which would have made recognition of the aircraft's attitude extremely difficult. The pilot's attention during the landing flare would have been concentrated on the visual environment outside of the aircraft, and it is likely that the pilot attempted to establish the missed approach attitude using outside references. That the aircraft was at various bank angles of wings level, 10° left, 45° left, and 10° left, until the ailerons jammed, indicates that the pilot had lost control of the aircraft during the missed approach attempt. Once the aileron jammed, the pilot could no longer control the bank of the aircraft. To maintain a nearly straight ground track of 261°, the aircraft would have had to be banking back and forth along the entire track. The pilot also did not maintain the required nose-up pitch attitude; simulator trials and examination of the aircraft's climb performance demonstrated that the aircraft would have flown away from the ground had such an attitude been maintained.

A pilot commencing a missed approach with reference to the cockpit instruments would normally select the go-around mode on the flight director so the V-bars could command the proper aircraft attitude on the attitude director indicator.

Had the Gander ACC operational staff been aware of the RADEX capability to quickly identify an aircraft's last recorded radar position and had that information been provided to the agencies conducting the search, the aircraft crash site would have been located much sooner.

Findings

1. The flight crew was certified and qualified for the flight in accordance with existing regulations.

2. The St. John's FSS operator did not have the actual Stephenville wind direction and speed. The wind velocity he passed to the crew was from the latest Stephenville observation and was 040° at 17 knots, within the tailwind landing limitations of the aircraft.

3. The actual Stephenville wind of 040° magnetic at 20 knots with gusts to 22 knots exceeded the aircraft's maximum allowable tailwind component for landing.

4. The pilot attempted a missed approach after the aircraft had touched down in the snow, just off the runway surface.

5. The pilot did not maintain the correct aircraft attitude for a missed approach.

6. The pilot did not select the go-around mode on the flight director during the missed approach.

7. The CVR cockpit area microphone channel was not recorded for undetermined reasons.

8. The capabilities of RADEX to quickly locate a missing aircraft were not known to the Gander ACC operational management staff.

9. All major aircraft components were identified at the wreckage site, and no mechanical malfunction was identified.

10. Engine and instrument analysis identified that both engines were operating at high power during the impact.

11. There was an ELT installed in the aircraft, although, according to FARs, the aircraft was not required to be so equipped. The ELT did not activate at impact; the batteries were not the correct type and were overdue for replacement.

Causes and Contributing Factors

Shortly after crossing the runway threshold, the aircraft began moving to the left of the runway. The motion probably was undetected by the pilot until the aircraft touched down off the left side of the runway surface. The pilot did not maintain the proper aircraft attitude during an attempted missed approach, and the aircraft struck the terrain.

Safety Action Taken

The capability of RADEX to quickly locate the last radar position of missing or overdue aircraft was recognized by NAV CANADA authorities and action was taken to make the equipment and the program available to operations personnel in all ACCs for use in similar occurrences. NAV CANADA conducted training sessions for Data Systems Controllers in all ACCs specifically aimed at the use of RADEX as a search tool.

As a result of this accident and in an effort to enhance the safety of operations at Stephenville airport, the Airport Authority initiated discussions with NAV CANADA and Transport Canada to establish an Authorized Approach Unicom (AAU) service to provide operational information to pilots for the purpose of conducting instrument approaches published in the Canada Air Pilot (CAP). An AAU is authorized to provide airport advisory services including surface wind speed and direction, current altimeter setting and runway condition (surface condition, vehicles, etc.) to aircraft.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board, consisting of Chairperson Benoît Bouchard, and members Maurice Harquail, Charles Simpson and W.A. Tadros, authorized the release of this report on 17 September 1997.