# Air Safety Investigation Office (ASIO)

**BOMBARDIER**

***TECHNICAL MEMO***

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| **DATE** | Wednesday, February 7th, 2024 |
| **MEMO REFERENCE NO.** | ASIO-2024-ML-002 |
| **SUBJECT** | Landing Performance Assessment – Learjet 55 N558RA (MSN 55-086) – Runway Excursion at Mission Field Airport (KLVM) on January 11th, 2024 |
| **FROM** | Bombardier Air Safety Investigation Office (ASIO) |
| **TO** | U.S. National Transportation Safety Board (NTSB) |
| **ASIO CASE REF. NO.** | A10CE.55-086.11-1-24 |
| **NTSB CASE REF NO.** | WPR24LA071 |

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## *Introduction*

On January 11th, 2024, about 0837 mountain standard time, Learjet 55 N558RA (MSN 55-086) overran the end of the runway while landing on runway 22 at Mission Field Airport (KLVM), Livingston, Montana. After departing the runway, the aircraft continued down into a ravine and came to a stop. The aircraft was substantially damaged and the two pilots sustained minor injuries. There were no passengers on-board. The U.S. National Transportation Safety Board (NTSB) opened an investigation into the circumstances of the accident.

The NTSB requested that Bombardier carry out a landing performance assessment for an aircraft landing on a snow-covered runway without the use of thrust reversers. This memo provides the requested assessment.

## *Assumptions*

The following assumptions have been made for this landing performance assessment:

- Landing weight: 16,200 lbs
- Field elevation at KLVM: 4646 feet Mean Sea Level (MSL)
- Runway slope: 0.07% (up)
- Winds: 090/12 (8 knot tailwind, 9 knot crosswind)
- Ambient temperature: -17 deg C
- Anti-ice: OFF
- Anti-skid: ON
- Flaps: 40 degrees
- Thrust Reversers: stowed

## *Reference Landing Approach Speed ($V_{REF}$)*

Reference landing approach speed ($V_{REF}$) is obtained from figure 5-56 (Figure 1, below) of the Airplane Flight Manual (AFM; FM-103).

With the assumed landing weight, the $V_{REF}$ is approximately 130 knots.

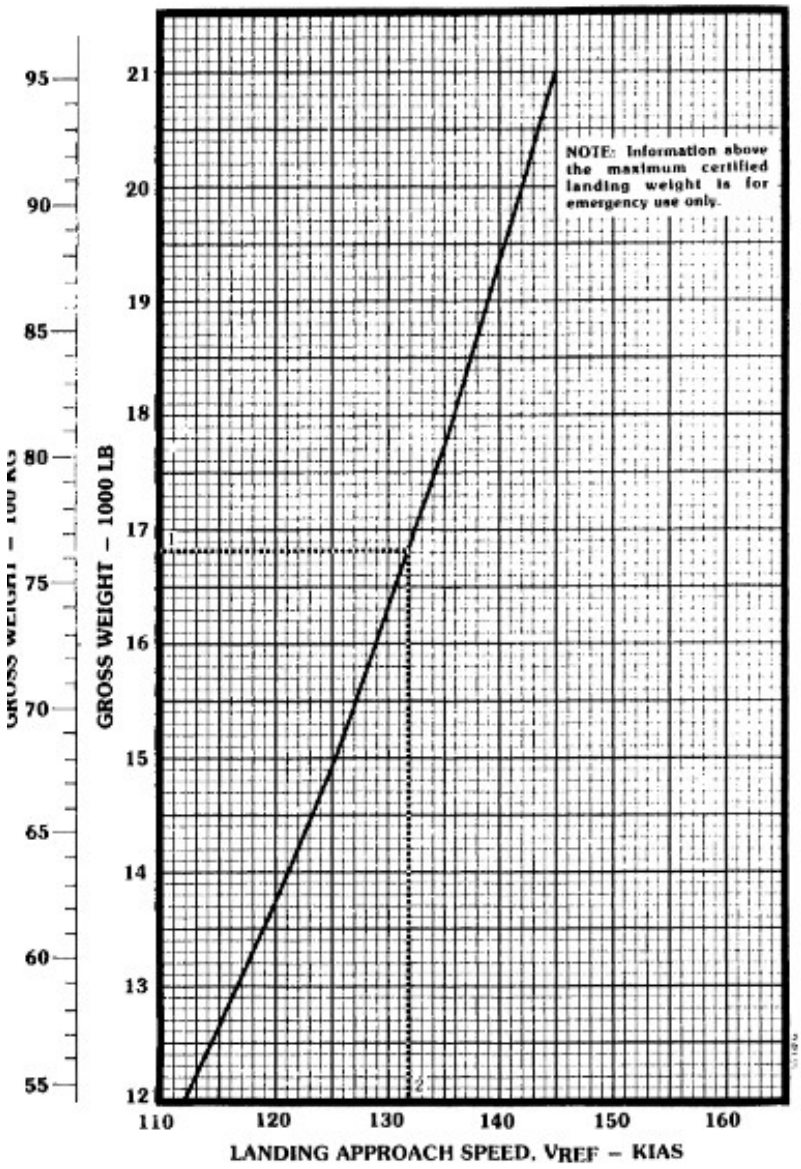


***Figure 1: AFM figure 5-56***

## *Dry Runway Actual Landing Distance*

The dry runway Actual Landing Distance (ALD) is obtained from figure figure 5-57 (Figure 2, below) of the AFM.

With the assumed landing weight, temperature, field elevation,tailwind, runway gradient and anti-skid ON, the ALD (Dry) is approximately 3,350 feet.

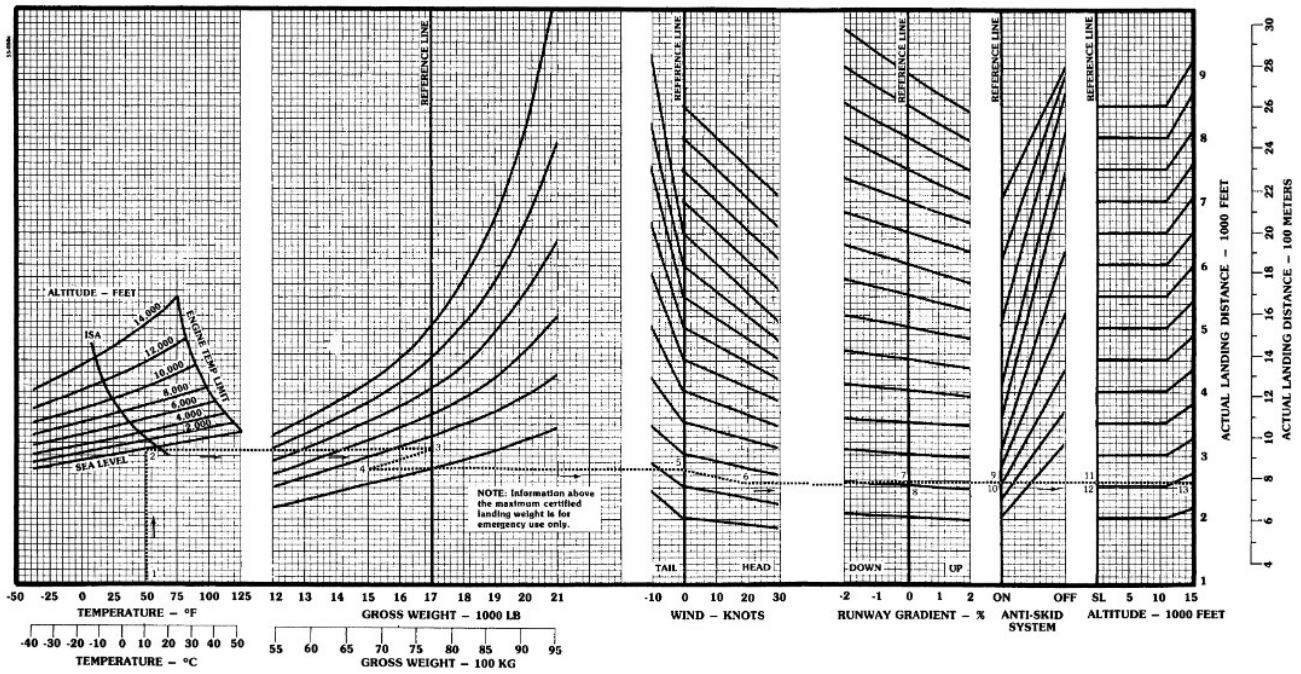


***Figure 2: AFM figure 5-57***

## *Snow-Covered Runway Landing Distances Without Tailwind*

Contaminated runway landing distances are obtained by multiplying the dry runway ALD by the appropriate contaminated runway landing distance factor provided in the Wet/Contaminated Runway Data Addendum.

The factors in the Addendum are based on flaps at 40 degrees, anti-skid ON, no tailwind component, and runway gradients between -1.0% and +2.0%.

The Addendum provides a factor of 2.0 for loose snow, yielding a landing distance of 6,700 feet, and a factor of 1.7 for compacted snow, yielding a landing distance of 5,695 feet.

## *Snow-Covered Runway Landing Distances With Tailwind*

No landing distance data is published for landings with tailwind on snow-covered runways. However, a rough estimate can be made by calculating a factor to account for the additional forward energy imparted to the aircraft at touchdown as a result of the tailwind adding velocity relative to the ground.

One way to calculate such a factor is to use the square of the ratio of the actual true airspeed at touchdown (aircraft velocity relative to the ground, including the contribution of the tailwind) to $V_{REF}$ converted to true airspeed (the airspeed for which the published landing distances were calculated).

The $V_{REF}$ converted to true airspeed (assuming no difference between calibrated and indicated) yields 133 knots. The actual true airspeed at touchdown is assumed to be $V_{REF}$ converted to true airspeed plus the tailwind component, 133 knots plus 8 knots, or 141 knots. The square of 141 divided by 133 yields a factor of 1.124.

Multiplying the loose snow landing distance of 6,700 feet by 1.124 yields 7,531 feet. Multiplying the compacted snow landing distance of 5,695 feet by 1.124 yields 6,401 feet.

## *Conclusion*

The landing performance assessment yielded the following results:

- $V_{REF}$: 130 knots
- Dry runway actual landing distance: 3,350 feet
- Loose snow landing distance, no tailwind: 6,700 feet
- Compacted snow landing distance, no tailwind: 5,695 feet
- Loose snow landing distance, with tailwind, estimated: 7,531 feet
- Compacted snow landing distance, with tailwind, estimated: 6,401 feet

Note that the above assumes that the crew elected to fly $V_{REF}$ for the landing. If a higher speed were flown, the estimated landing distances would be higher.