

Air Safety Investigation Office (ASIO)

TECHNICAL MEMO

BOMBARDIER

DATE Friday, December 15th, 2023

MEMO REFERENCE NO. ASIO-2023-ML-031

SUBJECT Landing Performance Assessment – Learjet 45XR N988MC (MSN 45-352) – Runway Excursion at Batesville Regional Airport (KBVX) on November 29th, 2022

FROM Bombardier Air Safety Investigation Office (ASIO)

TO U.S. National Transportation Safety Board (NTSB)

ASIO CASE REF. NO. T00008WI.45-352.29-11-22

NTSB CASE REF NO. CEN23LA056

Introduction

On November 29th, 2022, about 1910 central standard time, Learjet 45XR N988MC (MSN 45-352) overran the end of the runway while landing on runway 08 at Batesville Regional Airport (KBVX), Batesville, Arkansas. The aircraft was substantially damaged and the two pilots sustained minor injuries. The six passengers on-board were not injured. The airplane was operated as a Title 14 Code of Federal Regulations Part 91 business flight. The U.S. National Transportation Safety Board (NTSB) opened an investigation into the circumstances of the accident. Bombardier's Air Safety Investigation Office (ASIO) supported the investigation as an NTSB Party Member.

The NTSB requested that Bombardier carry out a landing performance assessment for an aircraft landing with flaps at 40 degrees (normal landing flaps). This memo provides the requested assessment.

Assumptions

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

- Field elevation at KBVX: 463 feet Mean Sea Level (MSL)
- Runway slope: 0.22% (up)
- Winds: 230/3 (3 knot tail wind)
- Ambient temperature: 18 deg C
- Autospoilers: deployed
- Anti-skid: ON
- Flaps: 40 degrees
- Thrust Reversers: stowed
- Landing weight: 19,200 lbs

Reference Landing Approach Speed (V_{REF})

Reference landing approach speed (V_{REF}) is obtained from figure 5-112.1 of the Airplane Flight Manual (AFM; FM-126D US).

With the assumed landing weight and field elevation, the V_{REF} is 123 knots (value highlighted in yellow on Figure 1).

VAPP and VREF — KIAS							
ALT FEET	WEIGHT LB	VAPP	VREF	ALT FEET	WEIGHT LB	VAPP	VREF
4000 and BELOW	14,000	115	106	10,000	14,000	117	108
	15,000	119	110		15,000	121	111
	16,000	122	113		16,000	124	115
	17,000	125	116		17,000	128	118
	18,000	129	119		18,000	131	121
	19,000	132	122		19,000	134	124
	19,200	132	123		19,200	135	124
	20,000	134	125		20,000	137	126
	21,000	137	127		21,000	139	129
	21,500	138	128		21,500	141	130

Figure 1: Extract from AFM figure 5-112.1

V_{REF} : 123 knots

Uncorrected Dry Runway Actual Landing Distance

The uncorrected dry runway actual landing distance is obtained by interpolating from data provided in figure 5-120.1 of the AFM.

For the assumed landing weight, the following values are obtained from the AFM (values highlighted in yellow on Figure 2):

- @ Sea level, 15 deg C: 2,660 feet
- @ Sea level, 20 deg C: 2,700 feet
- @ 1000 feet, 15 deg C: 2,740 feet
- @ 1000 feet, 20 deg C: 2,780 feet

Interpolating for the assumed field elevation, the following values are obtained:

- @ 463 feet, 15 deg C: 2,697 feet
- @ 463 feet, 20 deg C: 2,737 feet

Interpolating for the assumed ambient temperature, an uncorrected dry runway actual landing distance of 2,721 feet is obtained.

ALT FT	WT LB	TEMPERATURE																												
			-40	-20	0	20	40	60	70	80	90	100	110	120		-40	-30	-20	-10	0	10	15	20	25	30	35	40	45	50	
		°F													°C															
SEA LEVEL	14,000		1900	1950	2000	2050	2100	2150	2170	2200	2220	2240	2270	2290	2320	2340	2370	2400	2420	2450										
	15,000		1980	2030	2080	2140	2190	2240	2270	2290	2320	2340	2370	2400	2420	2450	2480	2500	2520	2550										
	16,000		2050	2100	2160	2220	2270	2320	2350	2380	2410	2430	2460	2490	2520	2550	2580	2600	2620	2650										
	17,000		2120	2180	2230	2290	2350	2410	2440	2470	2510	2540	2570	2600	2630	2660	2690	2710	2740	2770										
	18,000		2190	2250	2310	2380	2440	2510	2540	2580	2610	2650	2680	2710	2750	2780	2810	2840	2870	2900										
	19,000		2250	2320	2390	2460	2530	2600	2640	2680	2710	2750	2780	2820	2860	2890	2920	2950	2980	3010										
	19,200		2270	2340	2410	2480	2550	2620	2660	2700	2730	2770	2810	2840	2880	2920	2950	2980	3010	3040										
	20,000		2330	2400	2470	2550	2620	2700	2740	2780	2810	2850	2890	2930	2970	3010	3040	3080	3110	3140										
	21,000		2400	2480	2560	2640	2720	2800	2840	2880	2920	2960	3000	3040	3080	3130	3160	3200	3230	3260										
	21,500		2440	2520	2600	2680	2760	2850	2890	2930	2970	3010	3060	3100	3140	3190	3230	3270	3300	3340										
1000	14,000		1940	2000	2050	2100	2150	2200	2230	2250	2280	2300	2330	2350	2380	2400	2430	2460	2480	2510										
	15,000		2030	2080	2140	2190	2240	2300	2320	2350	2380	2400	2430	2460	2480	2510	2540	2560	2590	2620										
	16,000		2100	2160	2210	2270	2330	2380	2410	2440	2470	2500	2530	2560	2590	2620	2650	2680	2710	2740										
	17,000		2170	2230	2290	2350	2410	2480	2510	2550	2580	2610	2640	2680	2710	2740	2770	2800	2830	2870										
	18,000		2240	2310	2380	2440	2510	2580	2620	2650	2690	2720	2760	2800	2830	2870	2900	2930	2970	3010										
	19,000		2310	2390	2460	2530	2610	2680	2720	2760	2790	2830	2870	2910	2950	2990	3020	3060	3100	3140										
	19,200		2330	2400	2480	2550	2630	2700	2740	2780	2820	2860	2890	2930	2970	3010	3040	3080	3110	3140										
	20,000		2390	2470	2550	2620	2700	2780	2820	2860	2900	2940	2980	3020	3070	3110	3160	3200	3250	3300										
	21,000		2470	2550	2630	2720	2800	2880	2930	2970	3010	3060	3100	3140	3190	3230	3270	3300	3340	3380										
	21,500		2510	2590	2680	2760	2850	2940	2980	3020	3070	3110	3160	3200	3250	3300	3340	3380	3420	3460										

Figure 2: Extract from AFM figure 5-120.1

Uncorrected dry runway actual landing distance: 2,721 feet

Corrected Dry Runway Actual Landing Distance

The uncorrected dry runway actual landing distance is corrected for assumed wind and runway slope (no correction for anti-skid ON), per figure 5.121 of the AFM (red line in Figure 3).

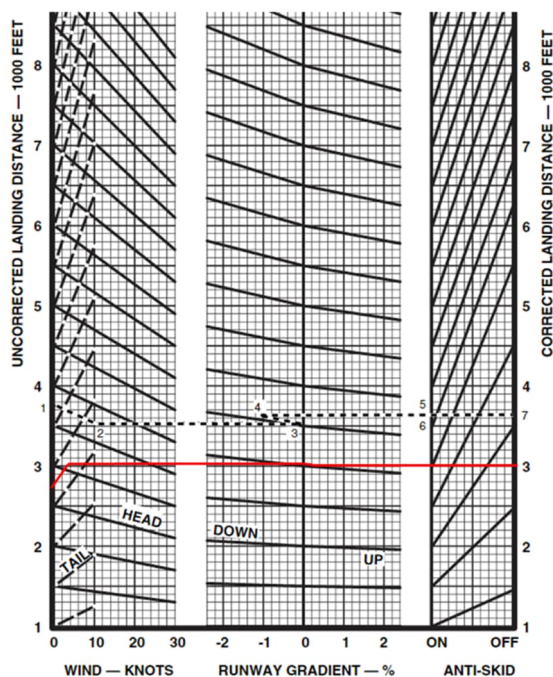


Figure 3: Extract from AFM figure 5-121

Corrected dry runway actual landing distance: 3,000 feet

Factored Landing Field Length

The factored landing field lengths for dry and wet runway conditions are determined using figure 5.122 of the AFM (red lines in Figure 4).

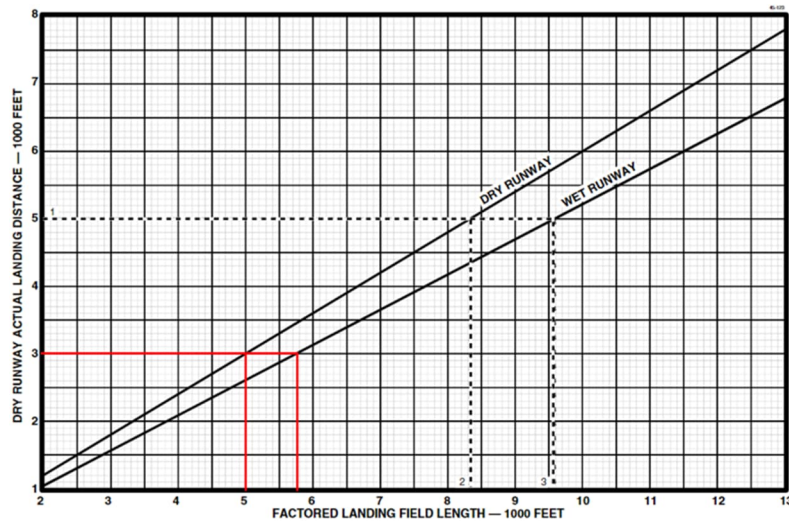


Figure 4: Extract from AFM figure 5-122

Factored landing field length (dry): 5,000 feet

Factored Landing Field Length (Wet): 5,760 feet

Uncorrected Wet Runway Actual Landing Distance

The uncorrected wet runway actual landing distance is obtained by interpolating from data provided in figure 67.1 of the Contaminated Runway Data (CRD).

For the assumed landing weight, the following values are obtained from the CRD (values highlighted in yellow on Figure 5):

- @ Sea level, 15 deg C: 3,340 feet
- @ Sea level, 20 deg C: 3,390 feet
- @ 1000 feet, 15 deg C: 3,450 feet
- @ 1000 feet, 20 deg C: 3,500 feet

Interpolating for the assumed field elevation, the following values are obtained:

- @ 463 feet, 15 deg C: 3,391 feet
- @ 463 feet, 20 deg C: 3,441 feet

Interpolating for the assumed ambient temperature, an uncorrected wet runway actual landing distance of 3,421 feet is obtained.

ALT FT	WT LB	TEMPERATURE																
		°F	-40	-20	0	20	40	60	70	80	90	100	110	120	°C	-40	-30	-20
SEA LEVEL	14,000		2220	2300	2370	2440	2510	2590	2630	2660	2700	2740	2780	2830	2880	2920		
	15,000		2340	2420	2490	2570	2650	2730	2770	2810	2850	2890	2940	2990	3040	3100		
	16,000		2450	2530	2610	2690	2780	2860	2910	2950	2990	3040	3090	3140	3200	3250		
	17,000		2550	2640	2730	2820	2910	3000	3040	3090	3130	3180	3230	3300	3350	3420		
	18,000		2660	2750	2840	2940	3040	3130	3180	3230	3270	3320	3380	3450	3510	3580		
	19,000		2760	2860	2960	3060	3160	3260	3310	3360	3410	3460	3530	3590	3660	3730		
	19,200		2780	2880	2980	3080	3180	3280	3340	3390	3440	3490	3550	3630	3690	3760		
	20,000		2860	2960	3070	3170	3280	3380	3440	3490	3550	3600	3670	3740	3810	3880		
	21,000		2960	3070	3180	3290	3400	3510	3570	3630	3680	3740	3810	3890	3960	4040		
	21,500		3010	3120	3230	3350	3460	3570	3630	3690	3750	3810	3880	3960	4030	4110		
1000	14,000		2290	2360	2440	2510	2590	2670	2710	2740	2790	2830	2880	2930	2980	3030		
	15,000		2410	2490	2570	2650	2730	2820	2860	2900	2940	2990	3040	3100	3150	3210		
	16,000		2520	2600	2690	2780	2870	2950	3000	3040	3090	3140	3190	3250	3310	3370		
	17,000		2630	2720	2810	2910	3000	3100	3140	3190	3240	3290	3350	3420	3480	3540		
	18,000		2740	2840	2940	3040	3130	3240	3280	3330	3390	3450	3510	3580	3640	3710		
	19,000		2850	2950	3050	3160	3260	3370	3420	3470	3530	3590	3660	3730	3800	3870		
	19,200		2870	2970	3080	3180	3290	3390	3450	3500	3560	3620	3690	3760	3830	3910		
	20,000		2950	3060	3170	3280	3390	3500	3560	3610	3670	3730	3800	3880	3960	4030		
	21,000		3050	3170	3280	3400	3510	3630	3690	3750	3810	3880	3950	4030	4110	4190		
	21,500		3110	3220	3340	3460	3570	3690	3750	3810	3880	3950	4030	4110	4190	4270		

Figure 5: Extract from CRD figure 67.1

Uncorrected wet runway actual landing distance: 3,421 feet

Corrected Wet Runway Landing Distance

The uncorrected wet runway actual landing distance is corrected for assumed wind, runway slope, and thrust reversers stowed (no correction for anti-skid ON), per figure 68.1 of the CRD (red line in Figure 6).

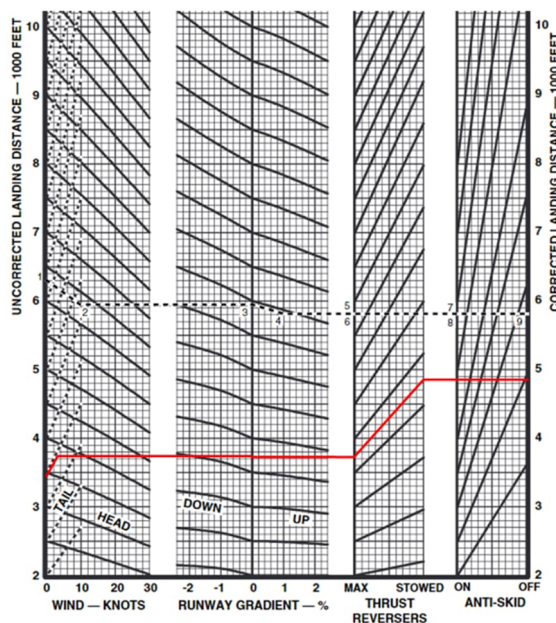


Figure 6: Extract from CRD figure 68.1

Corrected wet runway actual landing distance: 4,845 feet

Conclusion

The landing performance assessment yielded the following results:

- V_{REF} : 123 knots
- Uncorrected dry runway actual landing distance: 2,721 feet
- Corrected dry runway actual landing distance: 3,000 feet
- Factored landing field length (dry): 5,000 feet
- Factored Landing Field Length (Wet): 5,760 feet
- Uncorrected wet runway actual landing distance: 3,421 feet
- Corrected wet runway actual landing distance: 4,845 feet