



# Aviation Investigation Final Report

<b>Location:</b>	Jacksonville, Florida	<b>Accident Number:</b>	ERA21LA077
<b>Date &amp; Time:</b>	December 16, 2020, 14:19 Local	<b>Registration:</b>	N661EP
<b>Aircraft:</b>	Embraer EMB-500	<b>Aircraft Damage:</b>	Substantial
<b>Defining Event:</b>	Runway excursion	<b>Injuries:</b>	3 None
<b>Flight Conducted Under:</b>	Part 91: General aviation - Executive/Corporate		

## Analysis

The flight crew performed an instrument landing system approach in heavy rain. The published unfactored landing distance, which assumes ideal conditions for airplane speed, flightpath, and maximum braking immediately after touchdown, was about 330 ft shorter than the landing distance available. The factored landing distance, which 1) provides a safety margin and 2) allows for some variance from the ideal conditions, was about 1,360 ft longer than the landing distance available. During the approach, when the airplane was about 50 ft above the runway, the airspeed was about 4 knots higher than the target speed.

After touchdown, the pilot(s) began braking within 1-2 seconds; however, the brake pedals did not reach their maximum braking position until about 8 seconds after touchdown. The brake pedals remained in the maximum position for 3 seconds before the parking/emergency brake was applied. The parking brake activation, which is not protected by the anti-skid system, resulted in the locking of both main landing gear wheelsets, reducing braking performance significantly. As a consequence of the wheels locking, the anti-skid system was deactivated, as designed. The airplane departed the end of the runway at a speed of about 60 knots and sustained substantial damage.

## Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this accident to be:

The flight crew's failure to apply maximum braking immediately upon touchdown, which resulted in a runway excursion. Contributing to the accident were 1) the slightly excessive

approach airspeed and 2) the flight crew's decision to land on a wet runway during heavy rain with little margin between the unfactored landing distance required and the landing distance available.

## Findings

<b>Personnel issues</b>	Use of equip/system - Pilot
<b>Aircraft</b>	Airspeed - Incorrect use/operation
<b>Environmental issues</b>	Rain - Use of related info
<b>Personnel issues</b>	Decision making/judgment - Flight crew

## Factual Information

### History of Flight

Landing-landing roll	Runway excursion (Defining event)
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On December 16, 2020, at 1419 eastern standard time, an Embraer EMB-500, N661EP, was substantially damaged when it overran the runway during landing at Jacksonville Executive Airport at Craig (CRG), Jacksonville, Florida. The pilot, copilot, and passenger were not injured. The airplane was operated as a Title 14 *Code of Federal Regulations* Part 91 corporate flight.

According to the pilot, he performed an instrument landing system approach to runway 32 at CRG. He landed in the touchdown zone at a speed of 100 knots. After the airplane slowed to 80 knots, he applied full manual braking, but the airplane “was not reducing speed for stop as expected.” As the airplane approached the departure end of the runway, he attempted to apply the emergency brake three times, with no response. As the airplane rolled into the grass, he attempted to activate the emergency brake again, with no response. He applied left rudder to avoid colliding with the approach lights. As the airplane came to a stop the right wing contacted the ground.

The airplane sustained substantial damage to the right wing, a portion of the right main landing gear punctured the right wing near its root.

The automated terminal information system (ATIS) information Kilo, issued at 1353 was tuned in on the airplane’s radio and recorded on the cockpit voice recorder at about 1355. The weather information included wind from 100° at 4 knots, visibility of  $\frac{3}{4}$  mile, thunderstorms in the vicinity with heavy rains and mist, few clouds at 300 ft and an overcast layer at 4,000 ft. The 1418 weather conditions reported at CRG included wind from 250° at 3 knots, visibility  $\frac{1}{4}$  statute mile, heavy rain in thunderstorms, and mist, and a broken cloud ceiling at 300 ft above ground level (AGL). The remarks section of the weather observation included a note indicating the previous 1-hour precipitation water equivalent was 0.32 inches.

According to the airplane Quick Reference Handbook (QRH), for a gross weight of 9,500 lbs. (the appropriate next higher value in the landing data from the pilot’s reported value of 9,331 lbs.), the landing reference speed was 104 knots, and the unfactored wet runway landing distance required was 3,679 ft. Unfactored landing distances are not adjusted (or ‘factored’) for any safety margin additives and assume that several criteria are met during landing. According to the airplane flight manual (AFM) these criteria are):

- ? Steady three degree angle approach at VREF in landing configuration

- ? VREF airspeed maintained at runway threshold
- ? Idle thrust established at runway threshold
- ? Attitude maintained until MLG touchdown
- ? Maximum brake applied immediately after MLG touchdown
- ? Antiskid system operative

The AFM further advises "If these performance techniques are not strictly used for a typical landing made during normal operations, the distances may be longer."

Additionally, the QRH lists factored landing distances, which are intended to provide a safety margin to the landing distance required, as well as account for other variables such as the effects of temperature, increased approach speed, and reduced wheel braking. The factored wet runway landing distance in this case was 5,368 ft.

Runway 32 at CRG is 4,008 x 100 ft with an asphalt surface that was not grooved.

A review of the cockpit voice recorder revealed that the crew performed a standard approach briefing at 1358, shortly after tuning in the ATIS. At 1411, air traffic control (ATC) asked the crew if they wanted to try the approach, or instead hold due to heavy precipitation over the airfield. The crew advised that they would like to try the approach, and ATC cleared them for the ILS to runway 32. At 1413 the flight was cleared to land on runway 32, and the control tower advised that there was a broken cloud layer at 300 ft. The crew continued the approach and touched down at 1417:29.

A review of data from the flight data recorder revealed that when the airplane was on approach about 50 ft above ground level, the airspeed was about 108 knots (groundspeed 107 kts). The touchdown occurred about 1,250 ft from the threshold of runway 32 at an airspeed (and groundspeed) of 100 knots. The brake pedals began to move 1-2 seconds after touchdown and increased until they reached 100 percent travel about 8 seconds after touchdown, at which time the airspeed was 88 knots. About 11 seconds after touchdown at an airspeed of 81 knots, the parking brake was applied for 9 seconds, and the main landing gear wheels stopped rotating. After the parking brake was released, the right main landing gear began to rotate again, the brake pedal position reduced before increasing again, asymmetrically, with more pressure on the left pedal than the right. The airplane departed the end of runway within about 1 second of the parking brake release, at an airspeed of about 60 knots.

The airplane was not equipped with thrust reversers or ground spoilers.

Examination and testing of the brake control unit (BCU) was performed at the manufacturer's facility and overseen remotely by NTSB investigators. A review of the data captured by the unit's non-volatile memory revealed that one fault that pertained to the accident landing was recorded, "Lt whl not turning" (left main landing gear wheel not turning). This fault would cause the BCU to send an "Anti-Skid" fault annunciation to a display in the cockpit. This annunciation was captured by the flight data recorder and occurred just after the application of the

emergency brake and locking of both main landing gear wheelsets, which disables the anti-skid system by design. Testing of the BCU revealed no anomalies that would have precluded normal operation.

### Pilot Information

<b>Certificate:</b>	Commercial	<b>Age:</b>	39,Male
<b>Airplane Rating(s):</b>	Multi-engine land	<b>Seat Occupied:</b>	Left
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Unknown
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Class 1 With waivers/limitations	<b>Last FAA Medical Exam:</b>	August 18, 2020
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	January 9, 2020
<b>Flight Time:</b>	2162 hours (Total, all aircraft), 358 hours (Total, this make and model), 1055 hours (Pilot In Command, all aircraft), 38 hours (Last 90 days, all aircraft), 18 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

### Co-pilot Information

<b>Certificate:</b>	Airline transport	<b>Age:</b>	25,Male
<b>Airplane Rating(s):</b>	Single-engine land; Multi-engine land	<b>Seat Occupied:</b>	Right
<b>Other Aircraft Rating(s):</b>	None	<b>Restraint Used:</b>	Unknown
<b>Instrument Rating(s):</b>	Airplane	<b>Second Pilot Present:</b>	Yes
<b>Instructor Rating(s):</b>	None	<b>Toxicology Performed:</b>	
<b>Medical Certification:</b>	Class 1 Without waivers/limitations	<b>Last FAA Medical Exam:</b>	June 8, 2020
<b>Occupational Pilot:</b>	Yes	<b>Last Flight Review or Equivalent:</b>	March 28, 2020
<b>Flight Time:</b>	2125 hours (Total, all aircraft), 18 hours (Total, this make and model), 1350 hours (Pilot In Command, all aircraft), 69 hours (Last 90 days, all aircraft), 18 hours (Last 30 days, all aircraft), 1 hours (Last 24 hours, all aircraft)		

## Aircraft and Owner/Operator Information

<b>Aircraft Make:</b>	Embraer	<b>Registration:</b>	N661EP
<b>Model/Series:</b>	EMB-500	<b>Aircraft Category:</b>	Airplane
<b>Year of Manufacture:</b>	2009	<b>Amateur Built:</b>	
<b>Airworthiness Certificate:</b>	Normal	<b>Serial Number:</b>	50000123
<b>Landing Gear Type:</b>	Retractable - Tricycle	<b>Seats:</b>	8
<b>Date/Type of Last Inspection:</b>	Unknown	<b>Certified Max Gross Wt.:</b>	10472 lbs
<b>Time Since Last Inspection:</b>		<b>Engines:</b>	2 Turbo fan
<b>Airframe Total Time:</b>	2466 Hrs	<b>Engine Manufacturer:</b>	Pratt & Whitney Canada
<b>ELT:</b>	C126 installed	<b>Engine Model/Series:</b>	PW617F-E
<b>Registered Owner:</b>		<b>Rated Power:</b>	1695 Lbs thrust
<b>Operator:</b>		<b>Operating Certificate(s) Held:</b>	None

## Meteorological Information and Flight Plan

<b>Conditions at Accident Site:</b>	Instrument (IMC)	<b>Condition of Light:</b>	Day
<b>Observation Facility, Elevation:</b>	CRG,41 ft msl	<b>Distance from Accident Site:</b>	1 Nautical Miles
<b>Observation Time:</b>	14:18 Local	<b>Direction from Accident Site:</b>	155°
<b>Lowest Cloud Condition:</b>		<b>Visibility</b>	0.25 miles
<b>Lowest Ceiling:</b>	Broken / 300 ft AGL	<b>Visibility (RVR):</b>	
<b>Wind Speed/Gusts:</b>	3 knots /	<b>Turbulence Type Forecast/Actual:</b>	None / None
<b>Wind Direction:</b>	250°	<b>Turbulence Severity Forecast/Actual:</b>	N/A / N/A
<b>Altimeter Setting:</b>	29.93 inches Hg	<b>Temperature/Dew Point:</b>	12°C / 11°C
<b>Precipitation and Obscuration:</b>	Moderate - None - Fog		
<b>Departure Point:</b>	Miami, FL (OPF)	<b>Type of Flight Plan Filed:</b>	IFR
<b>Destination:</b>	Jacksonville, FL	<b>Type of Clearance:</b>	IFR
<b>Departure Time:</b>	12:00 Local	<b>Type of Airspace:</b>	Class D

## Airport Information

<b>Airport:</b>	Jacksonville Executive Airport at Craig CRG	<b>Runway Surface Type:</b>	Asphalt
<b>Airport Elevation:</b>	41 ft msl	<b>Runway Surface Condition:</b>	Wet
<b>Runway Used:</b>	32	<b>IFR Approach:</b>	ILS
<b>Runway Length/Width:</b>	4008 ft / 100 ft	<b>VFR Approach/Landing:</b>	None

## Wreckage and Impact Information

<b>Crew Injuries:</b>	2 None	<b>Aircraft Damage:</b>	Substantial
<b>Passenger Injuries:</b>	1 None	<b>Aircraft Fire:</b>	None
<b>Ground Injuries:</b>	N/A	<b>Aircraft Explosion:</b>	None
<b>Total Injuries:</b>	3 None	<b>Latitude, Longitude:</b>	30.344503,-81.519576(est)

## Administrative Information

Investigator In Charge (IIC):	Brazy, Douglass		
Additional Participating Persons:	Donald Andrews; FAA/FSDO; Orlando, FL		
Original Publish Date:	February 7, 2023	Investigation Class:	3
Note:	The NTSB did not travel to the scene of this accident.		
Investigation Docket:	<a href="https://data.nts.gov/Docket?ProjectID=102425">https://data.nts.gov/Docket?ProjectID=102425</a>		

The National Transportation Safety Board (NTSB), established in 1967, is an independent federal agency mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The NTSB makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

The Independent Safety Board Act, as codified at 49 U.S.C. Section 1154(b), precludes the admission into evidence or use of any part of an NTSB report related to an incident or accident in a civil action for damages resulting from a matter mentioned in the report. A factual report that may be admissible under 49 U.S.C. § 1154(b) is available [here](#).