Aviation Investigation Final Report

Location:	Houston, Texas	**Accident Number:**	DCA23LA384
Date & Time:	July 29, 2023, 10:34 Local	**Registration:**	N641UA
Aircraft:	Boeing 767-322	**Aircraft Damage:**	Substantial
Defining Event:	Hard landing	**Injuries:**	202 None
Flight Conducted Under:	Part 121: Air carrier - Scheduled		

Analysis

After a stabilized approach, the main landing gear of United Airlines flight 702 touched down and the nosewheel contacted the runway harder than expected. The airplane then bounced, and the first officer (the pilot flying) reacted by pulling the control yoke aft to keep the nosewheel from impacting the runway a second time. The first officer applied the thrust reversers, the speed brakes deployed, and the nosewheel bounced a second time. Subsequently, the nosewheel impacted the runway a third time and, the airplane began to decelerate normally. The abnormal nosewheel impacts with the runway resulted in substantial damage to the fuselage.

Although the first officer stated he held aft pressure on the control column during the initial touchdown, flight data showed that he also made nose-down column inputs during the landing sequence. These nose-down inputs contributed to the nosewheel abnormally impacting the runway.

Normal operation of the speedbrakes includes deployment during initial main gear touchdown, if the speedbrakes are in the armed position and the thrust levers are at idle. The only indication that the speedbrakes are armed is a demarcation line located on the control stand. If they do not automatically deploy during main gear touchdown, the pilot monitoring (in this case, the captain) announces the abnormal operation and slowly raises the speedbrake handle to the up position while the pilot flying slowly lowers the airplane's nose to the runway. In addition, the speedbrakes will automatically deploy if the airplane is on the ground and either thrust lever is moved to the reverse idle detent.

However, the speedbrakes were not armed before landing and after the airplane's first bounce, data showed the speedbrakes automatically deployed with the first officer's application of the

thrust reversers, as designed. The deployment of the speedbrakes with the thrust reversers was while the nosewheel was still in the air. This likely contributed to the second abnormal runway contact of the nosewheel and the subsequent damage to the airplane. It is also likely that neither flight crewmember noticed that the speedbrakes were not armed before landing.

Crew Performance

De-rotation is the lowering of the aircraft's nose gear to the runway following touchdown on the main gear during landing. The first officer's nose-down column inputs were contrary to United Airlines' procedures and training. The first officer's training records showed inconsistencies in airplane handling as recent as a few months before the accident. He received an unsatisfactory performance rating and, upon re-evaluation, a satisfactory rating with a condition to recheck after 90 days (instead of 9 months). This was due to, among other things, marginal performance with landings.

According to the check airman who completed the first officer's second evaluation, the purpose of the recheck was to ensure, due to the first officer's previous "struggles," that his "proficiency is up to standards". The first officer had accumulated about 129 flight hours in the accident airplane make and model. Due to the satisfactory performance rating on the first officers second evaluation, the investigation was unable to determine if the first officers training inconsistencies contributed to the accident.

Probable Cause and Findings

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

The first officer's improper control inputs after the airplane touched down. Contributing to the severity of the damage was the flight crew's lack of recognition that the speedbrakes were not armed, which led to their delayed deployment.

Findings

Personnel issues	Incorrect action performance - Copilot
Organizational issues	Initial training - Operator

Factual Information

History of Flight

Landing-flare/touchdown	Hard landing (Defining event)

On July 29, 2023, about 1034 central daylight time (CDT), United Airlines flight 702, a Boeing 767-322, N641UA, sustained substantial damage while landing at George Bush Intercontinental Airport (IAH), Houston, Texas. The 202 passengers and crew aboard the airplane were not injured. The flight was operating as a Title 14 *Code of Federal Regulations* Part 121 scheduled domestic passenger flight from Newark Liberty International Airport (EWR), Newark, New Jersey, to IAH.

The first officer (FO) was the pilot flying, and the captain was the pilot monitoring. The flight crew reported that the departure from EWR and the cruise segment of the flight were uneventful. The airplane was cleared for the DOOBI2 arrival to IAH and then the instrument landing system approach to runway 26L. According to the flight crew, the airplane was fully configured for landing, on speed, and in compliance with the company's stable approach criteria, and the initial touchdown on the main wheels was normal.

The FO stated that, after the main landing gear touched down, he held aft pressure on the control yoke to keep the nosewheel from hitting the runway, but the nosewheel contacted the runway with "abnormal force." The airplane seemed to bounce, and the FO reacted by pulling the control yoke aft to keep the nosewheel from impacting the runway a second time.

Flight data recorder (FDR) data indicated that control column inputs ranged from about 5° nose high to 5° nose low during the landing. Data also indicated that the speedbrakes deployed simultaneously as the thrust reversers transitioned from not deployed to deployed, and the nosewheel bounced a second time. Subsequently, the nosewheel contacted the runway a third time and the airplane began to decelerate.

The captain assumed control of the airplane, and the remainder of the landing rollout was normal.

Pilot Information

Certificate:	Airline transport	**Age:**	62,Male
Airplane Rating(s):	Multi-engine land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	5-point
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	May 29, 2023
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	June 12, 2023
Flight Time:	(Estimated) 23000 hours (Total, all aircraft), 5500 hours (Total, this make and model), 15000 hours (Pilot In Command, all aircraft), 142 hours (Last 90 days, all aircraft), 40 hours (Last 30 days, all aircraft)		

Co-pilot Information

Certificate:	Airline transport; Commercial	**Age:**	41,Male
Airplane Rating(s):	Single-engine land; Multi-engine land	**Seat Occupied:**	Right
Other Aircraft Rating(s):	None	**Restraint Used:**	
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	Airplane multi-engine; Airplane single-engine	**Toxicology Performed:**	
Medical Certification:	Class 1 Without waivers/limitations	**Last FAA Medical Exam:**	March 7, 2023
Occupational Pilot:	Yes	**Last Flight Review or Equivalent:**	May 5, 2023
Flight Time:	3001 hours (Total, all aircraft), 129 hours (Total, this make and model), 1998 hours (Pilot In Command, all aircraft), 129 hours (Last 90 days, all aircraft)		

The Captain

The captain was hired by United Airlines in April 2001 as a first officer. At the time of the accident, the captain was based at EWR, and he held type ratings in the Airbus 320 and Boeing 737, 757, and 767.

According to the captain's training records, his most recently completed training included a proficiency check and emergency drill training on June 12, 2023, crew resource management on April 24, 2023, and initial operating experience on October 23, 2022. His most recent line check was completed on January 21, 2023.

The First Officer

The FO was hired by United Airlines on February 7, 2023. At the time of the accident, the first officer was based at EWR, and he held type ratings on several airplanes, including the Boeing 757 and 767.

The first officer completed the required training and his initial line-oriented evaluation checkride on April 28, 2023, receiving an unsatisfactory performance rating due to deficiencies with takeoffs and aircraft control. During his second checkride, the FO obtained a satisfactory performance rating but received the minimum grade in three areas, one of which was landings, which resulted in a "short cycle."

A short cycle allowed the first officer to proceed with operating experience but required him to be evaluated in 90 days rather than the normal period of 9 months. According to the check airman who completed the FO's second line-oriented evaluation, the purpose of the short cycle was to ensure that the FO's "proficiency is up to standards" given his previous "struggles."

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N641UA
Model/Series:	767-322	**Aircraft Category:**	Airplane
Year of Manufacture:	1991	**Amateur Built:**	
Airworthiness Certificate:	Transport	**Serial Number:**	25091
Landing Gear Type:	Retractable - Tricycle	**Seats:**	213
Date/Type of Last Inspection:	January 26, 2023 Continuous airworthiness	**Certified Max Gross Wt.:**	350043 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo fan
Airframe Total Time:	126184 Hrs at time of accident	**Engine Manufacturer:**	P&W
ELT:	Installed, not activated	**Engine Model/Series:**	PW4060-3
Registered Owner:	UNITED AIRLINES INC	**Rated Power:**	60000 Lbs thrust
Operator:	UNITED AIRLINES INC	**Operating Certificate(s) Held:**	Flag carrier (121)

The speedbrake on the accident airplane was controlled by the speedbrake lever, which was located on the control stand. The speedbrake had three positions: down, armed, and up, which were identified by demarcation lines.

The *Boeing 767 Flight Crew Operations Manual*, dated October 11, 2019, stated in part the following:

> *The speedbrake lever can be placed in an intermediate position between ARMED and UP.*
>
> *In the ARMED position, when the landing gear is fully on the ground (not tilted) and the thrust levers are at idle, the speedbrake lever is driven aft to the UP position and the spoiler panels are fully extended.*
>
> *On the ground, when either thrust lever is moved to the reverse idle detent, the speedbrake lever is driven to the up position and the spoiler panels are fully extended. The speedbrake lever does not need to be in the ARMED position.*

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual (VMC)	**Condition of Light:**	Day
Observation Facility, Elevation:	KIAH,90 ft msl	**Distance from Accident Site:**	1 Nautical Miles
Observation Time:	09:53 Local	**Direction from Accident Site:**	249°
Lowest Cloud Condition:	Scattered / 2500 ft AGL	**Visibility**	10 miles
Lowest Ceiling:	Broken / 25000 ft AGL	**Visibility (RVR):**	
Wind Speed/Gusts:	5 knots / None	**Turbulence Type Forecast/Actual:**	/
Wind Direction:	220°	**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	30.14 inches Hg	**Temperature/Dew Point:**	30°C / 23°C
Precipitation and Obscuration:	No Obscuration; No Precipitation		
Departure Point:	Newark , NJ (EWR)	**Type of Flight Plan Filed:**	IFR
Destination:	Houston, TX	**Type of Clearance:**	IFR
Departure Time:	08:00 Local	**Type of Airspace:**	Class B

IAH was equipped with an automated surface observing system. A review of the observations 15 minutes before and 10 minutes after the accident revealed that the wind was coming from the south-southwest at a speed of 5 knots or less.

Airport Information

Airport:	GEORGE BUSH INTCNTL/HOUSTON IAH	**Runway Surface Type:**	Concrete
Airport Elevation:	95 ft msl	**Runway Surface Condition:**	Dry
Runway Used:	08R/26L	**IFR Approach:**	ILS
Runway Length/Width:	9402 ft / 150 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	9 None	**Aircraft Damage:**	Substantial
Passenger Injuries:	193 None	**Aircraft Fire:**	None
Ground Injuries:		**Aircraft Explosion:**	None
Total Injuries:	202 None	**Latitude, Longitude:**	29.983833,-95.338167

A postaccident examination of the airplane revealed damage to the crown of the upper fuselage. The fuselage skin was buckled and fractured, as shown in figure 1, with damage to the underlying stringers and frames.

Figure 1. Close-up view of the airplane damage on the left side of the fuselage (Source: United Airlines).

Flight recorders

A review of FDR data revealed that the airplane touched down on both main wheels, with a control column position of about 0.35° and the speedbrake handle in the down (unarmed) position. After the initial touchdown, the maximum recorded control column positions during the landing sequence were 5.71° to -4.75°, as shown in figure 2. FDR data also showed that the airplane rolled to the left and that the right main landing gear lifted off the runway's surface. Subsequently, the nosewheel impacted the runway with a force equivalent of about 1.4 gravitational force equivalent (G). The thrust reversers were in transit as the speedbrakes deployed, and the nosewheel impacted the runway a second time with a force of about 1.6 G and bounced. Subsequently, the nosewheel impacted the runway a third time with a force of about 1.6 G.

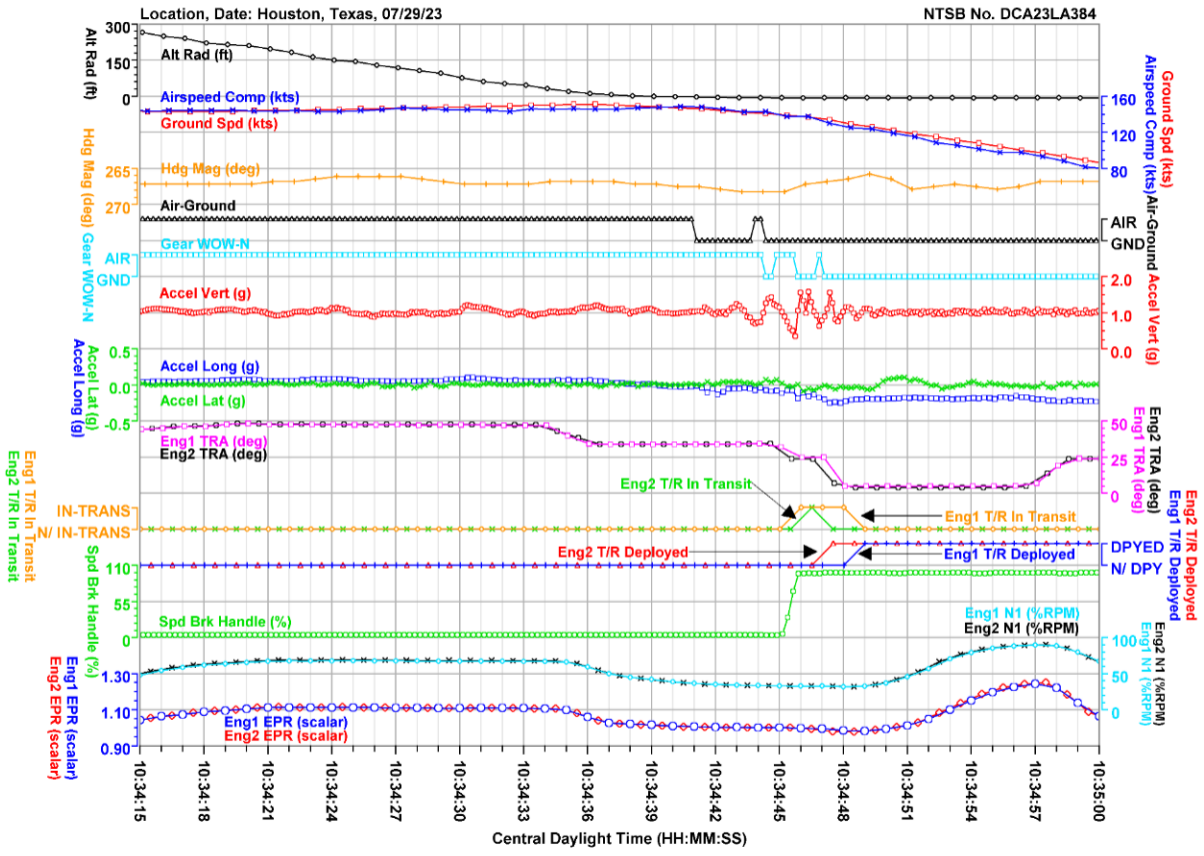

Figure 2. FDR data pertinent to the circumstances of this accident.

United Airlines *757-767 Flight Manual*

The United Airlines *757-767 Flight Manual*, dated June 30, 2023, Normals, Landings, stated in part the following:

> [PF, PM] Touchdown and rollout. . . . . Accomplish/monitor
>
> Ensure that the airplane is not allowed to pitch up after touchdown. Fly the nose down to the runway.
>
> For a normal landing, plan for touchdown at least 1000 feet from the threshold. Hold sufficient back pressure on the control column to keep the pitch attitude constant. Touchdown should occur at an airspeed of no less than VREF. This typically results in main gear touchdown approximately 1500-1800 feet from the threshold.
>
> If the EICAS advisory AUTOBRAKE displays or if deceleration is not normal, brake manually.
>
> [PM] Speed brakes. . . . . Monitor
>
> Announce abnormal operation. If automatic extension fails, the Captain slowly raises the speed brakes to the up position while the nose is smoothly lowered to the runway.

Boeing 767 *Flight Crew Training Manual*

The Boeing 767 *Flight Crew Training Manual*, dated June 30, 2023, provided the following landing procedure guidance:

> *After main gear touchdown, initiate the landing roll procedure. Fly the nose wheels smoothly onto the runway without delay. IF the speedbrakes do not extend automatically move the speedbrake lever to the UP position without delay. Control column movement forward of neutral should not be required. Do not attempt to hold the nose wheels off the runway. Holding the nose up after touchdown for aerodynamic braking is not an effective braking technique and results in high nose gear sink rates upon brake application and reduced braking effectiveness.*

To avoid possible airplane structural damage, do not make large nose down control column movements before the nose wheels are lowered to the runway.

The Boeing 767 *Flight Crew Training Manual* also provided the following flare and touchdown guidance:

The techniques discussed here are applicable to all landings including one engine inoperative landings, crosswind landings and landings on slippery runways. Unless an unexpected or sudden event occurs, such as windshear or collision avoidance situation, it is not appropriate to use sudden, violent or abrupt control inputs during landing….

When the threshold passes out of sight under the airplane nose shift the visual sighting point to the far end of the runway. Shifting the visual sighting point assists in controlling the pitch attitude during the flare. Maintaining a constat airspeed and descent rate assists in determining the flare point. Initiate the flare when the main gear is approximately 20 to 30 feet above the runway by increasing the pitch attitude approximately 2° - 3°. This slows the rate of descent.

After the flare is initiated, smoothly retard the thrust levers to idle, and make small pitch attitude adjustments to maintain the desired descent rate to the runway. A smooth thrust reduction to idle also assists in controlling the natural nose-down pitch change associated with thrust reduction. Hold sufficient back pressure on the control column to keep the pitch attitude constant…. Ideally, main gear touchdown should occur simultaneously with thrust levers reaching idle.

Additional Information

De-rotation is the lowering of the aircraft's nose gear to the runway following touchdown on the main gear during landing. In a review of National Transportation Safety Board investigations and assisted international investigations, there were seven similar de-rotation accidents involving Boeing 757/767 aircraft. Those investigations were:

January 16, 1992 - Asiana Airlines in Cheu Island, South Korea
October 27, 1992 – American Airlines flight 957 in São Paulo, Brazil
December 31, 1993 – LOT flight 002 in Warsaw, Poland

July 31, 1997 – Federal Express in Newark, New Jersey
May 22, 2002 – Monarch Airlines in Gibraltar
April 20, 2009 – Royal Air Maroc flight 200 in New York, New York
August 18, 2019 – Delta Air Lines 414 in Ponta Delgada, Portugal

These accidents occurred when the pilots applied large nose-down control column deflections after main landing gear touchdown, which resulted in large nose-down pitch rates and high vertical velocities at the nose gear. It was this combination of vertical velocity and pitch rate that resulted in compression loads that exceeded the design loads of the forward fuselage crown structure.

Administrative Information

Investigator In Charge (IIC):	Banning, David
Additional Participating Persons:	Ryan Hurling; United Airlines Steve Demko; ALPA John Miller; Boeing Dave Keenan ; FAA
Original Publish Date:	January 16, 2025
Last Revision Date:	
Investigation Class:	Class 3
Note:	The NTSB did not travel to the scene of this accident.
Investigation Docket:	https://data.ntsb.gov/Docket?ProjectID=192744

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable causes of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for each accident or event we investigate. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, "accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties … and are not conducted for the purpose of determining the rights or liabilities of any person" (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB's statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)). A factual report that may be admissible under 49 *United States Code* section 1154(b) is available here.