

# National Transportation Safety Board

Office of Aviation Safety

Washington, DC 20594



DCA23LA384

## **OPERATIONAL FACTORS**

Group Chair's Factual Report

May 1, 2024

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## **A. ACCIDENT**

Location: Houston, Texas  
Date: July 29, 2023  
Time: 1034 central daylight time (CDT)<sup>1</sup>  
1534 universal time coordinate (UTC)  
Airplane: N641UA; Boeing 767-322; United flight 702 (UAL702)

## **B. OPERATIONAL FACTORS GROUP**

Group Chair                      Shawn Etcher  
National Transportation Safety Board  
Washington, D.C.

Group Member                  Todd Gentry  
FAA AVP-100  
Washington, D.C.

Group Member                  Ryan Hurling  
United Airlines  
Chicago, IL

Group Member                  Mark James Diaz  
Boeing  
Seattle, WA

Group Member                  Steve Demko  
United Airlines - ALPA  
Tysons Corner, VA

## **C. SUMMARY**

On July 29, 2023, about 1034 CDT, a Boeing 767-322, N641UA, operated by United Airlines, Inc. experienced a rapid derotation on landing on runway 26L at George Bush Intercontinental/Houston Airport (IAH), Houston Texas. The airplane sustained substantial structural damage and skin buckling; however, no injuries to the crew or passengers were reported. The airplane departed Newark Liberty International Airport (EWR), Newark, New Jersey about 0832 eastern daylight time. The flight was operated as a 14 *Code of Federal Regulations (CFR)* Part 121 flight, and IAH was the intended destination.

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<sup>1</sup> All times in this report will be in local (CDT) time. At the time of the accident local time was UTC-5 hours.

## **D. DETAILS OF THE INVESTIGATION**

### **1.0 Operational Factors Group Activities**

August 2, 2023 - The Operational Factors investigator was assigned to the event and immediately requested detailed crew statements, crew training records, crew schedules, and expanded landing checklist information.

### **2.0 History of Flight**

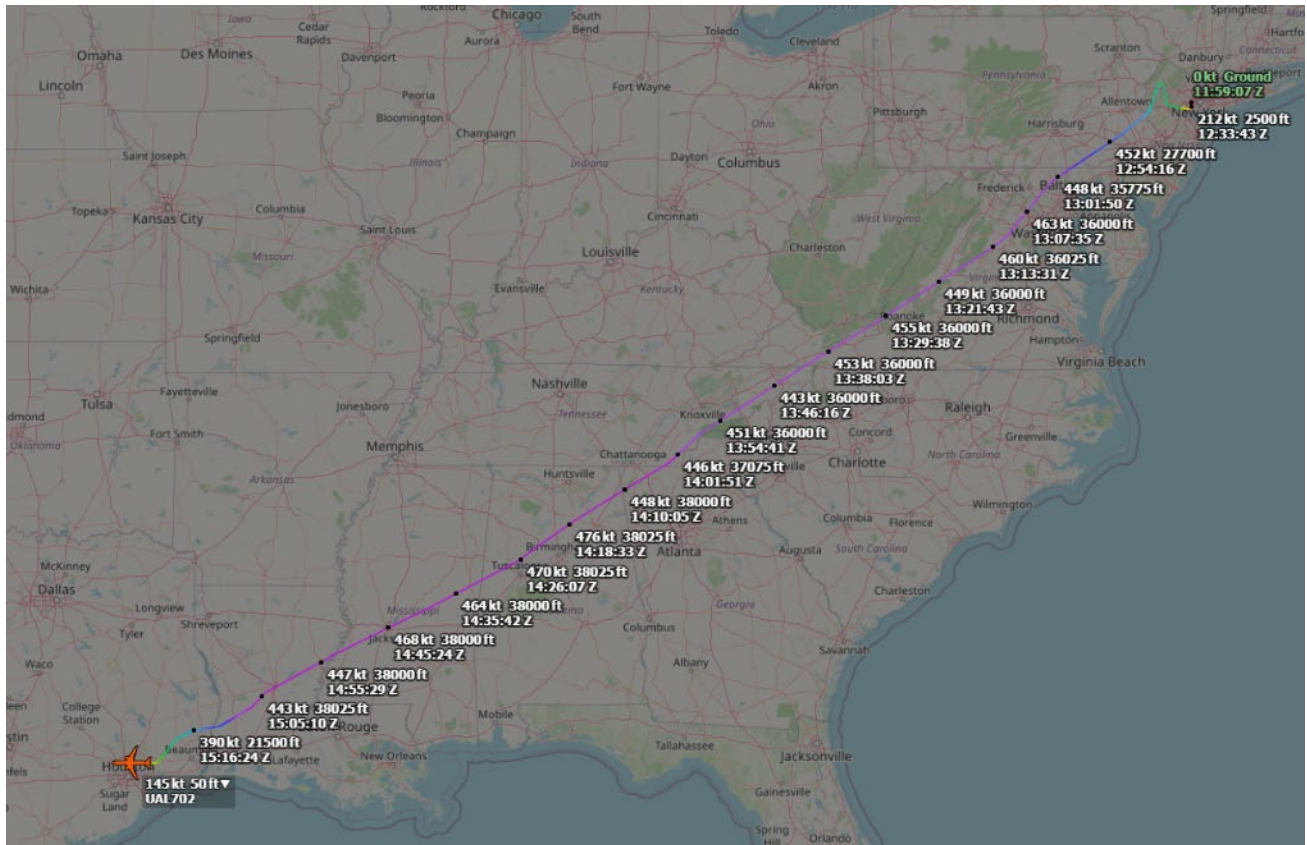
According to the flight's operational flight plan, it had a departure time of 0805. ADS-B data<sup>2</sup>, indicated that United flight 702 began the takeoff roll from Newark Liberty International Airport (EWR), Newark, New Jersey about 0832 eastern daylight time and departed to the south from runway 22R. The first officer was the pilot flying (PF) and the captain was the pilot monitoring (PM). The flight proceeded to the south until about 3,000 ft above mean sea level (msl), then turned to the west, then the northwest as it ascended out of 11,000 ft msl, then approximately 4 minutes later the flight turned towards the southwest and climbed to FL360. Approximately mid-flight the flight climbed to FL380 and continued to the southwest. About 1007 CDT the flight began a descent as it continued towards IAH.

Approximately 1025, the accident flight turned to the right and subsequently intercepted the extended centerline of runway 26L for IAH. The airplane continued to track the extended centerline and the last recorded data indicated that the airplane crossed the runway threshold at 1034:33 at 148 kts. According to the first officer's written statement "*The approach speeds were set at 137 kts (VREF), and the target speed was 143 kts*<sup>3</sup>." ACARS data indicated that the airplane touched down at 1034:45 and arrived at the gate at 1039:15.

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<sup>2</sup> Source: [ADS-B Exchange - track aircraft live \(adsbexchange.com\)](https://adsbexchange.com)

<sup>3</sup> Source: Operational Factors - Attachment 1 - Flight Crew Written Statements, pg. 7.



**Figure 1:** ADS-B Exchange Data for Accident Flight (Source: ADS-B Exchange)

### 3.0 Pilot Information

The flight crew consisted of a captain and first officer.

### 3.1 Captain Information

The captain was 62 years old and held an Airline Transport Pilot (ATP) certificate with a rating for multiengine land, and type ratings on the A-320<sup>4</sup>, B-737<sup>5</sup>, B-757<sup>6</sup>, and B-767 which included limitations of B-757 B-767 Circ. Apch - VMC<sup>7</sup> Only, and a Private pilot (Foreign Based) certificate for airplane single-engine land. He held a FAA first-class medical certificate dated May 29, 2023, with no limitations. At the time of the accident, he was based at EWR.

<sup>4</sup> Airbus SAS, A-318 Series, A-319 Series, A-320 Series, A-321, and includes all models on type certificate data sheet A28NM. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>5</sup> The Boeing Company, 737-100, 737-200, 737-200C, 737-300, 737-400, 737-500, 737-600, 737-700, 737-700C, 737-800, 737-900, 737-900ER, 737-8, 737-9. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>6</sup> The Boeing Company, 757-200 Series, 757-200PF Series, 757-200CB Series, 757-300 Series, 767-200 Series, 767-300 Series, 767-300F Series, 767-400ER Series, 767-2C Series. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>7</sup> Circling approach - visual meteorological conditions.

### 3.1.1 Captain's Certification Records

FAA records of the captain indicated the following:

Private Pilot - Airplane Single-Engine Land issued on basis of Canadian pilot license, not valid for agricultural aircraft operations certificate was issued March 30, 1982.

Airline Transport Pilot - Airplane Multiengine Land certificate was issued on September 30, 1991.

Airline Transport Pilot - Airplane Multiengine Land, A-320<sup>8</sup> certificate was issued on August 9, 2002.

Airline Transport Pilot - Airplane Multiengine Land, A-320, B-737<sup>9</sup>; Limitations: English Proficient certificate was issued on March 3, 2013.

Airline Transport Pilot - Airplane Multiengine Land, A-320, B-737, B-757<sup>10</sup>, B-767; Limitations: English Proficient, B-757 B-767 Circ. Apch - VMC Only certificate was issued on July 18, 2013.

### 3.1.2 Captain's Certificates and Ratings Held at time of the Accident

AIRLINE TRANSPORT PILOT (Issued July 18, 2013)

Airplane Multiengine Land  
A-320, B-737, B-757, B-767  
Limitations: English Proficient; Circ Apch - VMC Only  
Private Pilot (Foreign Based) Airplane Single-Engine Land

MEDICAL CERTIFICATE FIRST CLASS (issued May 29, 2023)

Limitations: None

### 3.1.3 Flight Hours

The following hours for the captain were provided by United Airlines:

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<sup>8</sup> Airbus SAS, A-318 Series, A-319 Series, A-320 Series, A-321 Series. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>9</sup> The Boeing Company, 737-100, 737-200, 737-200C, 737-300, 737-400, 737-500, 737-600, 737-700, 737-700C, 737-800, 737-900, 737-900ER, 737-8, 737-9. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>10</sup> The Boeing Company, 757-200 Series, 757-200PF Series, 757-200CB Series, 757-300 Series, 767-200 Series, 767-300 Series, 767-300F Series, 767-400ER Series, 767-2C Series. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

Previous 24 hours <sup>11</sup>	3:02
Previous 7 days	3:02
Previous 30 days	41:15
Previous 90 days	145:55
Total Hours B-767	5,665:58
Total Flight Experience	6,770:21

### 3.1.4 Training

The captain's training records were provided by United Airlines and an excerpt of the most recent training events are below:

Date of Hire with United Airlines	April 1, 2001
Initial Type Rating B-767	July 18, 2013
Most recent crew resources management training <sup>12</sup>	April 24, 2023
Initial operating experience (IOE) <sup>13</sup>	October 23, 2022
Most recent proficiency ride (simulator)	June 12, 2023
Most recent line check	January 21, 2023
Most recent Pilot Professional Development	January 14, 2023
Most recent FAA observation	October 22, 2022

### 3.2 First Officer Information

The first officer was 41 years old and held an Airline Transport Pilot (ATP) certificate with a rating for multiengine land, commercial certificate airplane single-engine land, type ratings on the, B-757, B-767, CL-65<sup>14</sup>, EMB-145<sup>15</sup>, ERJ-170<sup>16</sup>, ERJ-190 which included limitations of B-757 B-767 CL-65 EMB-145 Circ. Apch - VMC Only, ERJ-

<sup>11</sup> The accident flight was the first flight of the day for the captain and the only flight in the previous 24-hours.

<sup>12</sup> This training was part of the Continuing Qualification Distance Learning (CQDL) A Training which is a distance learning and self-study course.

<sup>13</sup> IOE consisted of 25:55 hours of flight experience, 6 flight segments and 5 landings. IOE concluded with a line check which was an additional 5:11 minutes and 1 landing.

<sup>14</sup> Bombardier Inc., CL-600-2B19, CL-600-2C10, CL-600-2D24, CL-600-2D15. Source: FAA Order 8900.1 Figure 5-88 dated March 29, 2024.

<sup>15</sup> Embraer S.A., EMB-135ER, EMB-135LR, EMB-135KE, EMB-135KL, EMB-135BJ, EMB-145, EMB-145ER, EMB-145MR, EMB-145LR, EMB-145XR, EMB-145MP, EMB-145EP. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>16</sup> Embraer S.A., ERJ 170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ-190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200 IGW, ERJ 190-300. Source: FAA Order 8900.1 Figure 5-88 dated March 29, 2024.



170 ERJ-190 SIC<sup>17</sup> privileges only. He held a FAA first-class medical certificate dated March 7, 2023, with no limitations. At the time of the accident, he was based at EWR.

### 3.2.1 First Officer's Certification Records

FAA records of the first officer indicated the following:

Private Pilot - Airplane Single-Engine Land; Limitation: English Proficient certificate was issued on December 15, 2017.

Private Pilot - Airplane Single-Engine Land; Instrument Airplane; Limitation: English Proficient certificate was issued on July 2, 2018.

Commercial Pilot - Airplane Single-Engine Land; Instrument Airplane; Limitation: English Proficient certificate was issued October 19, 2018.

Commercial Pilot - Airplane Single-Engine Land; Airplane Multiengine Land; Instrument Airplane; Limitation: English Proficient certificate was issued December 19, 2018.

Remote Pilot - Small Unmanned Aircraft System certificate was issued on September 5, 2019.

Airline Transport Pilot - Airplane Multiengine Land; EMB-145<sup>18</sup>; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: English Proficient; The EMB-145 is subject to Pilot-in-Command Limitation(s); ATP Circ. Apch. - VMC Only; EMB-145 Circ. Apch. - VMC Only certificate was issued on November 20, 2019.

Airline Transport Pilot - Airplane Multiengine Land; CL-65<sup>19</sup>, EMB-145; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: English Proficient; The CL-65, EMB-145 is subject to Pilot-in-Command Limitation(s); ATP Circ. Apch. - VMC Only; CL-65, EMB-145 Circ. Apch. - VMC Only certificate was issued on April 2, 2022.

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<sup>17</sup> Second in Command

<sup>18</sup> Embraer S.A., EMB-135ER, EMB-135LR, EMB-135KE, EMB-135KL, EMB-135BJ, EMB-145, EMB-145ER, EMB-145MR, EMB-145LR, EMB-145XR, EMB-145MP, EMB-145EP. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>19</sup> Bombardier Inc. CL-600-2B19, CL-600-2C10, CL-600-2D24, CL-600-2D15. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

Airline Transport Pilot - Airplane Multiengine Land; CL-65, EMB-145, ERJ-170<sup>20</sup>, ERJ-190; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: English Proficient; The CL-65, EMB-145 is subject to Pilot-in-Command Limitation(s); ATP Circ. Apch. - VMC Only; CL-65, EMB-145 Circ. Apch. - VMC Only, ERJ-190, ERJ-170 SIC Privileges Only certificate was issued on July 25, 2022.

Airline Transport Pilot - Airplane Multiengine Land; CL-65, EMB-145, ERJ-170<sup>21</sup>, ERJ-190; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: English Proficient; ATP Circ. Apch. - VMC Only; CL-65, EMB-145 Circ. Apch. - VMC Only, ERJ-190, ERJ-170 SIC Privileges Only certificate was issued on March 21, 2023.

Notice of Disapproval - Airline Transport Pilot Multiengine Land - Airplane was issued on April 28, 2023. Unsatisfactory items: Ill. Takeoffs and Landings - A. Normal Takeoff and Climb. Comments: Pitch inputs excessive (nose high, then nose lower than necessary to maintain climb. Referred to FSDO<sup>22</sup> for AELS<sup>23</sup> Determination.

Airline Transport Pilot - Airplane Multiengine Land; B-757, B-767, CL-65, EMB-145, ERJ-170<sup>24</sup>, ERJ-190; Commercial Pilot Privileges; Airplane Single-Engine Land; Limitations: English Proficient; ATP Circ. Apch. - VMC Only; B-757, B-767, CL-65, EMB-145 Circ. Apch. - VMC Only, ERJ-190, ERJ-170 SIC Privileges Only certificate was issued on May 5, 2023.

### **3.2.2 First Officer's Certificates and Ratings Held at time of the Accident**

AIRLINE TRANSPORT PILOT (Issued May 5, 2023)

Airplane Multiengine Land

B-757, B-767, CL-65, EMB-145, ERJ-170, ERJ-190

Commercial pilot privileges Airplane Single-Engine Land

Limitations: English Proficient; B-757, B-767, CL-65, EMB145 Circ Apch - VMC Only; ERJ-170, ERJ-190 SIC privileges only.

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<sup>20</sup> Embraer S.A. ERJ 170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ 190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200-IGW, ERJ 190-300. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>21</sup> Embraer S.A. ERJ 170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ 190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200-IGW, ERJ 190-300. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

<sup>22</sup> Flight Standards District Office.

<sup>23</sup> Aviation English Language Standard.

<sup>24</sup> Embraer S.A. ERJ 170-100 STD, ERJ 170-100 LR, ERJ 170-100 SU, ERJ 170-100 SE, ERJ 170-200 STD, ERJ 170-200 LR, ERJ 170-200 SU, ERJ 190-100 STD, ERJ 190-100 LR, ERJ 190-100 IGW, ERJ 190-100 ECJ, ERJ 190-200 STD, ERJ 190-200 LR, ERJ 190-200-IGW, ERJ 190-300. Source: FAA Order 8900.1, Figure 5-88, dated March 29, 2024.

REMOTE PILOT (certificate issued September 5, 2019)

Small Unmanned Aircraft System

FLIGHT ATTENDANT (March 16, 2017)

Group II - Carrier - United Airlines, Inc.

MEDICAL CERTIFICATE FIRST CLASS (issued March 7, 2023)

Limitations: None

### 3.2.3 Flight Hours

The following hours for the first officer were provided by United Airlines and FAA records:

Previous 24 hours <sup>25</sup>	3:02
Previous 7 days <sup>26</sup>	18:14
Previous 30 days <sup>27</sup>	62:34
Previous 90 days	129:13
Total Hours B-757/767 <sup>28</sup>	129:13
Total Flight Experience <sup>29</sup>	2,918:00
Total Flight Experience PIC <sup>30</sup>	1,915:00
Total Flight Experience SIC Airplane Multiengine Land <sup>31</sup>	888:00

### 3.2.4 Training

The first officer's training records were provided by United Airlines and an excerpt of the most recent training events are below:

Date of Hire with United Airlines	February 7, 2023
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<sup>25</sup> The accident flight was the first flight of the day for the first officer and the only flight in the previous 24-hours.

<sup>26</sup> The total included the accident flight. The first officer had operated a trip that began on July 25, 2023 and concluded on July 27, 2023, which included two flight segments.

<sup>27</sup> The total included the accident flight. During the month of July 2023 the first officer operated a total of five trips and nine flight segments, including the accident flight.

<sup>28</sup> Total hours in a B-757/767 included the 36:28 hours during his initial operating experience.

<sup>29</sup> Total Flight Experience was based on FAA Form 8710-1 "Airman Certificate and/or Rating Application," dated March 19, 2023.

<sup>30</sup> Total Flight Experience PIC was based on FAA Form 8710-1 "Airman Certificate and/or Rating Application," dated March 19, 2023.

<sup>31</sup> Total was based on FAA Form 8710-1 "Airman Certificate and/or Rating Application," dated March 19, 2023.

Initial Type Rating B-767	May 5, 2023
Most recent ground training	February 17, 2023
Basic Indoctrination <sup>32</sup>	February 17, 2023
Initial operating experience (IOE) <sup>33</sup>	May 30, 2023
Most recent line check <sup>34</sup>	May 31, 2023
Most recent line operating experience (LOE) <sup>35</sup>	May 5, 2023

According to the line check pilot who conducted the first officer's second checkride attempt, who had to be retested on CRM/TEM<sup>36</sup>, his technical knowledge, and his landings which he stated was a *"slight bounce but maintained pitch attitude until it settled back down and he was slightly left of centerline."*<sup>37</sup> The check airman further provided that because of having three events the first officer was placed on short cycle. According to the check airman a short cycle was *"...in the case of this individual...I gave him three 4s. So once you hit two 4s which is minimum performance in an event set. You're still sat. He hit a third one that turns him into a sat that's short cycle. Short cycle says...you're going to go out to do your OE...but we're going to bring you back in the building in 90 days instead of in 9 months because we ...you had some struggles. We want to get you back in the building for sim time and training time and make sure that your proficiency is up to standards."*<sup>38</sup>

#### 4.0 Airport Information

George Bush Intercontinental Airport (IAH)<sup>39</sup> was located 15 miles north of Houston, Texas, has a field elevation of 95.8 feet msl, and was located at a latitude/longitude of N029°59.04, W095°20.29. The airport was owned by the city of Houston and was serviced by an FAA Air Traffic Control Tower that was in operation 24 hours a day and was operational at the time of the accident. The airport conducted approximately 399,805 operations during 2022 of which 328,033 were air carrier operations. The airport had 5 paved landing surfaces for airplanes designated 08L/26R, 08R/26L, 09/27, 15L/33R, 15R/33L. Runway 26L, the landing runway, was 9,402 ft long and 150 ft wide and the elevation of the approach end of runway 26L was 92.3 ft msl.

<sup>32</sup> Basic Indoctrination began on February 7<sup>th</sup> and concluded on this date. Crew Resource Management is taught during Basic Indoctrination for all new-hire pilots.

<sup>33</sup> Initial operating experience included 32:07 hours, 8 flight segments, and 6 landings.

<sup>34</sup> The line check included 4:21 hours and included 1 landing.

<sup>35</sup> The LOE was first conducted on April 28, 2023; however, it was marked as "unsat." His second LOE was conducted on May 5, 2023 and was marked as "sat."

<sup>36</sup> Crew resource management/threat and error management.

<sup>37</sup> Source: Operational Factors - Attachment 2 - "Instructor Pilot Transcript" pg. 32 line 22 thru pg. 33 line 5.

<sup>38</sup> Source: Operational Factors - Attachment 2 - "Instructor Pilot Transcript" pg. 22 line 22 thru pg. 23 line 8.

<sup>39</sup> IAH airport information was obtained from the airport mast records. Source: [AirportIQ 5010 \(gcr1.com\)](https://www.airportIQ.com)

KIAH/IAH  
 Apt Elev 96'  
 N29 59.1 W095 20.5

JEPPESEN  
 18 MAR 22 (70-9) EIT 24 Mar

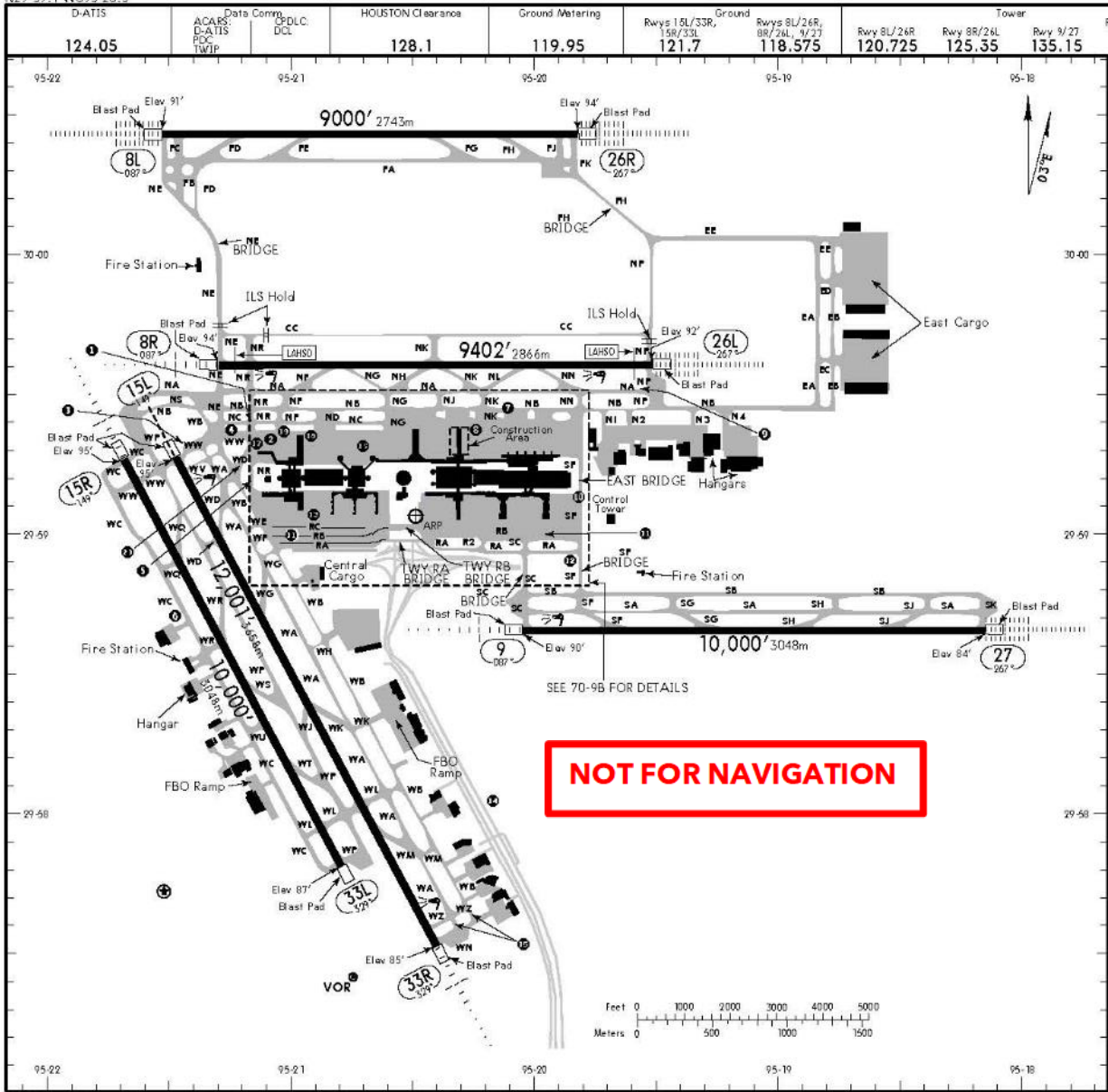


Figure 2: IAH Airport Diagram (Source: Jeppesen)

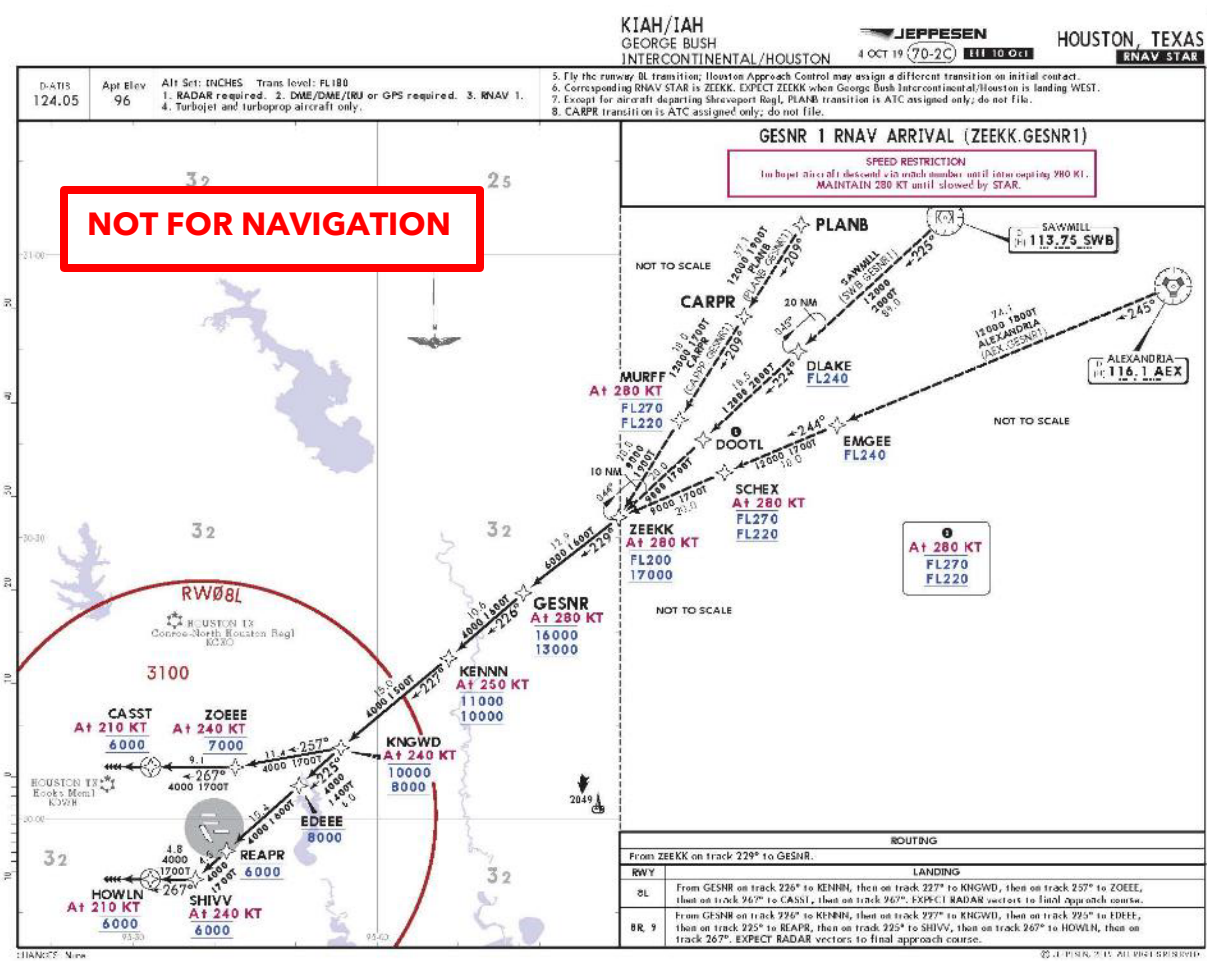


Figure 3: GESNR 1 RNAV Arrival Chart. (Source: Jeppesen)

### 5.0 Airplane Information.

The accident airplane was manufactured in 1991, was a 767-322 series aircraft, and was issued an airworthiness certificate on April 18, 1991 with a standard transport category certificate. The airplane was powered by two Pratt & Whitney PW4060 dual-spool, axial-flow, high-bypass turbofan engines, each capable of producing up to 99,040 lbs. of thrust.



**Figure 4:** Accident Airplane (Source: Jetphotos.com)

The accident flight consisted of a captain, a first officer, seven cabin crewmembers, 193 passengers, and two lap children. A review of the maintenance release document indicated that prior to departure from EWR the airplane had four deferred items. The items were:

- GCS Broadband Antenna Installed.*
- Galley Oven does not heat properly G1 Galley Oven 107.*
- Closeout panel cracked behind seat 10L.*
- Closeout panel cracked behind seat 4A.*

None of those deferred items would have contributed to this accident.

## 5.1 Weight and Balance

The following information was based on the weight and balance paperwork<sup>40</sup> provided to the accident flight crew by United Airlines at 0806:40. Airplane limitations are indicated in **bold** type. All weights below are in pounds (lbs.).

Basic Operating Weight	214,749
Payload	55,700
Zero Fuel Weight	270,449
<b>Maximum Zero Fuel Weight</b>	<b>270,470</b>

<sup>40</sup> Source: Operational Factors - Attachment 7 - "Accident Flight ACARS Data [Excerpts]"

Ramp Fuel <sup>41</sup>	49,100
Ramp Weight	319,549
Taxi Fuel	2,100
Takeoff Fuel	47,000
Takeoff Weight	317,449
<b>Maximum Takeoff Weight</b>	<b>350,000</b>
Planned Enroute Fuel Burn	30,146
Planned Landing Weight <sup>42</sup>	289,900

## 5.2 Flight Plan

A United Airlines dispatcher prepared and filed the following route information titled "RLS2" for the accident flight:

*DCT LANNA J48 EMI J48 CSN DCT FANPO Q40 AEX GESNR1*

Additionally, the flight plan contained the following dispatch remarks:

*RLS2 FOR TOGW INCREASE  
INCR TAXI FOR DEPT DELAYS  
CONVECTIVE ACTIVITY S OF RTE ALEAN-JAARE  
EXTRA FOR ALT DEVIATIONS/ANY ATC CONSTRAINTS.  
IAH ARR-13/CAP-17 BETWEEN 1545-1600Z HR.*

## 6.0 Meteorological Information

The IAH Airport was equipped with an ASOS<sup>43</sup>. The 15 minutes prior and 10 minutes following the landing recorded 5-minute weather observations<sup>44</sup> are listed below with the observation closest to the ADS-B data showing the airplane near the runway threshold in **bold** font:

*12960KIAH IAH20230729101510607/29/23 10:15:31 5-MIN KIAH 291615Z  
VRB05KT 10SM BKN043 32/20 A3013 -90 48 1900 VRB/05 RMK AO2  
T03220200*

*12960KIAH IAH20230729102010607/29/23 10:20:31 5-MIN KIAH 291620Z  
VRB03KT 10SM SCT043 32/20 A3013 -90 48 1900 VRB/03 RMK AO2  
T03220200*

<sup>41</sup> The flight dispatcher had requested 49,000 lbs. of fuel; however, according to the Weight & Balance report the flight crew reported 49,100 lbs. of fuel on board.

<sup>42</sup> Source: Operational Factors - Attachment 7 - "Accident Flight ACARS Data [Excerpts]"

<sup>43</sup> Automated Surface Observing System

<sup>44</sup> Source: [ncei.noaa.gov/data/automated-surface-observing-system-five-minute/access/2023/07/asos-5min-KIAH-202307.dat](https://ncei.noaa.gov/data/automated-surface-observing-system-five-minute/access/2023/07/asos-5min-KIAH-202307.dat)



12960KIAH IAH20230729102511307/29/23 10:25:31 5-MIN KIAH 291625Z  
VRB04KT 10SM FEW043 SCT050 33/21 A3013 -90 48 2000 VRB/04 RMK  
AO2 T03280206

12960KIAH IAH20230729103012007/29/23 10:30:31 5-MIN KIAH 291630Z  
21005KT 10SM FEW043 SCT050 BKN070 33/21 A3013 -90 48 2000  
210/05 RMK AO2 T03280206

**12960KIAH IAH20230729103512007/29/23 10:35:31 5-MIN KIAH  
291635Z 23005KT 10SM FEW043 SCT050 BKN070 33/21 A3012 -  
80 48 2000 230/05 RMK AO2 T03330211**

12960KIAH IAH20230729104011307/29/23 10:40:31 5-MIN KIAH 291640Z  
21004KT 10SM FEW048 SCT065 33/23 A3012 -80 55 2000 200/04 RMK  
AO2 T03280228

12960KIAH IAH20230729104511307/29/23 10:45:31 5-MIN KIAH 291645Z  
20003KT 10SM FEW050 FEW070 32/22 A3012 -80 55 1900 200/03 RMK  
AO2 T03220222

The observations show that prior to, during and after the event the wind does not become greater than 5 knots and was out of the south-southwest.

## **7.0 United Airlines Guidance**

The following guidance was provided to pilots via the United Airlines Flight Manual, Chapter 3 "Normals" Section 200 "Landing," dated June 30, 2023.

### **7.1 Landing General**

*Successful landings begin with a stabilized approach on speed, in trim, and on glidepath. Unstabilized approaches are the main cause of tailstrikes, hard landings, and runway excursions.*

*The PF calls for the Landing Checklist after calling for the final flap setting. Have the landing flaps set and the Landing Checklist completed by the 1000-foot callout.*

### **7.2 Landing Procedure**

**LANDING PROCEDURE**

- [PF] Gear down. . . . . Announce
- [PM] Gear. . . . . Down  
 (757) (763) Verify gear position by the EICAS (no GEAR DISAGREE message). Additional verification is that the gear handle is in the down detent, the three green down and locked lights are illuminated, and the amber GEAR light is extinguished.  
 (764) Verify gear position by the EICAS DOWN (green) message display.
- [PF/PM] Speed brake. . . . . Armed  
 Normally the Captain arms the speed brake.  
 Verify the speed brake lever is in the ARMED position.
- [PF] Flaps \_\_\_\_\_. Landing Checklist. . . . . Announce
- [PM] Flaps. . . . . \_\_\_\_\_  
 Verify the flap position indicator corresponds to the planned landing flap position.
- [PM] Landing Checklist. . . . . Accomplish
- [PF] Target speed. . . . . Verify set

**CAUTION:** *Rapid pitch increases may result in a tailstrike. See Normals>Landing>Landing Considerations>Tailstrike Avoidance.*

- [PF] Flare. . . . . Initiate  
 Initiate the flare when the main gear is approximately 20-30 feet above the runway by increasing the pitch attitude approximately 2-3°.

**WARNING:** *(752) With main gear struts compressed, tailstrike occurs at approximately 10.5° of pitch or approximately 12.5° with the main gear struts extended.*

**WARNING:** *(753) (767) With main gear struts compressed, tailstrike occurs at approximately 8° of pitch or approximately 9.5° with the main gear struts extended.*

- [PM] Pitch attitude. . . . . Monitor
- [PF] Thrust levers. . . . . Idle  
 Ensure the thrust levers are reduced to idle prior to touchdown.

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**WARNING:** *If a go-around is initiated after touchdown, a manual go-around must be conducted. The flight director go-around mode is not available until go-around is selected after becoming airborne. See Normals>Missed Approach/Go-Around.*

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- [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.
- 
- 

**WARNING:** *Do not attempt to go around after initiating reverse thrust.*

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- [PF] Reverse thrust. . . . . Initiate  
Immediately after main gear touchdown, raise both reverse thrust levers to the interlocks and hold light pressure until the interlocks release. Apply reverse thrust as needed.
- [PM] Thrust reverser indications (REV). . . . . Monitor  
Announce abnormal operation.
- [PM] Engine indications . . . . . Monitor  
Announce any abnormal engine indications.
- [PM] Airspeed . . . . . Announce "80 knots"

**WARNING:** *Maintain reverse thrust until stopping is assured. Be prepared to use maximum reverse thrust to control stopping in slippery conditions.*

- [PF] Reverse thrust . . . . . Reduce, as needed  
Reverse thrust may be reduced at a rate commensurate with the deceleration rate required for the runway condition and planned runway exit. As long as stopping is assured, reduce thrust to reverse idle between 80 knots and taxi speed. Stow reversers after engines have decelerated to idle.

**WARNING:** *If additional braking is required during rollout, override the autobrakes with a continuous application of maximum pedal pressure until assured that the airplane will stop within the remaining runway.*

**CAUTION:** *Do not use nose wheel steering tiller until reaching taxi speed.*

**CAUTION:** *When turning off from a wet or contaminated runway, slow to an appropriate speed (no greater than approximately 30 knots) to prevent skidding and excursions.*

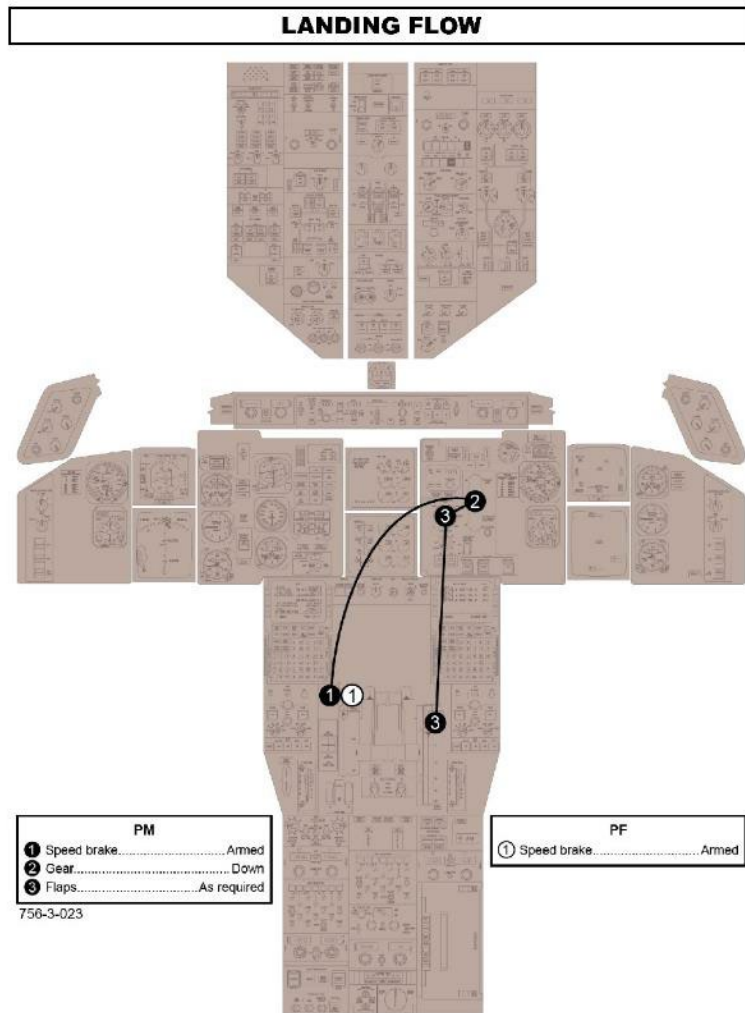
- [PF] Brakes. . . . . As required  
Disengage the autobrakes by smoothly applying manual brake pressure or once stopping is assured, by momentarily moving the speed brake lever slightly forward.  
Conditions permitting, high-speed turnoffs may be executed up to 60 knots, but groundspeed should be less than 10 knots for subsequent turns of more than 30° after runway exit.

Following a First Officer's landing, the Captain assumes control of the airplane before leaving the runway centerline. The Captain announces when he has positive control of the airplane.

**LANDING CHECKLIST**

CHALLENGE [PM]	RESPONSE [PM]
■ Speed brake . . . . .	Armed
■ Gear . . . . .	Down
■ Flaps . . . . .	_____

Additionally, the guidance provided a landing flow diagram for the pilot flying and pilot monitoring positions.



**Figure 5:** Landing Flow Diagram (Source: United Airlines Flight Manual).

### 7.2.1 Speed Brake Lever

The following photographs were captured in a United Airlines B-767-300 simulator during the operational factors group’s simulator evaluation. The photographs below are the view of the speed brake<sup>45</sup> and indicate the “DOWN” and the “ARMED” positions and markings. In order to go from “DOWN” to “ARMED” position, a pilot, would lift up on the lever and move the lever slightly aft until it was between the “DOWN” demarcation and the “ARMED” demarcation. The B-767-300 did not have a light or any other indication, besides visually looking at where the lever was located. During the simulator evaluation it was noted that the lever height when in the “DOWN” position was 3/8<sup>th</sup> of an inch less than when in the “ARMED” position. Boeing’s

<sup>45</sup> In this report “speed brake” and “speedbrake” are synonymous.

Speed Brake Lever Installation indicated that the full travel range of the speed brake lever was 78°.

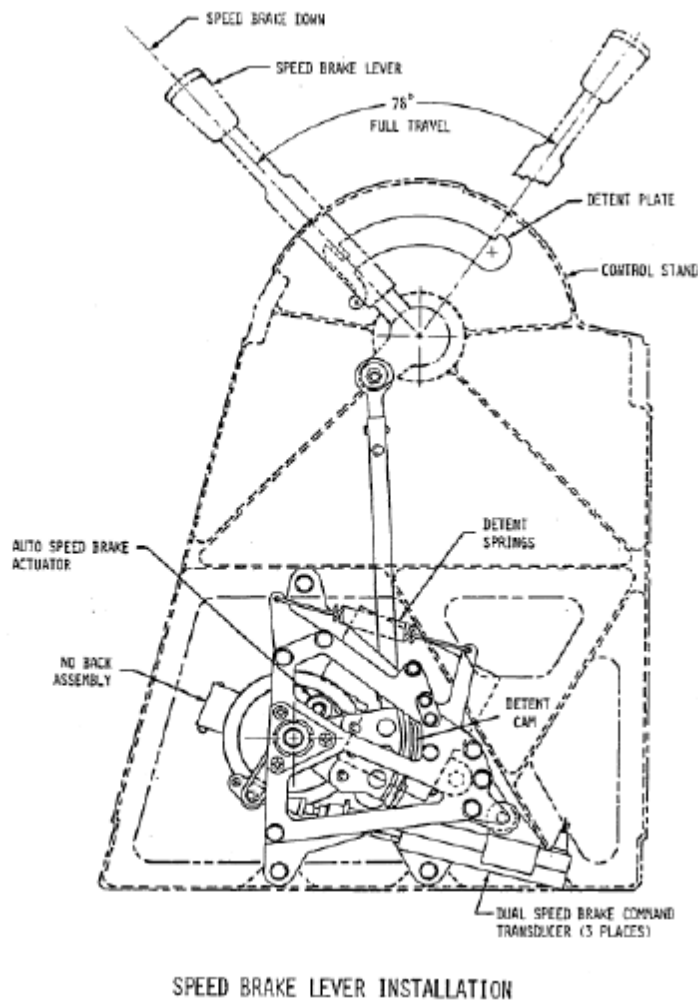


FIGURE 6

Image Copyright © Boeing. Reproduced with permission.

**Figure 6:** Boeing's Speed Brake Lever Installation

A review of the FDR data indicated that the speed brake lever was not in the "ARMED" position prior to landing. For further information about the simulator evaluation please reference "Operational Factors - Attachment 12 - Simulator Evaluation" located in the docket for this investigation.



**Figure 7:** View of Speed Brake Lever in "Armed" Position from Aft of the Center Pedestal. (Source: NTSB)



**Figure 8:** View from First Officer's Seat with Speed Brake Lever in "DOWN" Position. (Source: NTSB)





**Figure 9:** Speed Brake Lever in the "ARMED" Position as viewed from the First Officer's Seat and Lean Forward to look around the thrust reversers. (Source: NTSB)

## **8.0 Boeing Guidance**

The Boeing Flight Crew Training Manual provided a pictorial of a visual traffic pattern and an ILS approach. The pictorial provided various locations within the pattern or respective approach to arm the auto speed brakes. However, both pictures were

similar in that arming the speed brakes was to occur following the “Gear Down” and “Flaps 20” callouts during the landing checklist.

## **8.1 Balked Landing**

The Boeing 767 Flight Crew Training Manual provided the following guidance on conducting a “Balked Landing:”

*A balked landing is a discontinued landing attempt and go-around initiated at or after touchdown, but prior to initiation of reverse thrust. The balked landing technique maintains landing flap configuration to expedite climb away from the runway environment. Considerations for a balked landing include clearance of an obstacle in the runway environment, insufficient runway for continued landing, or transitioning to a go-around from a low-energy state.*

## **8.2 Landing Roll**

The Boeing 767 Flight Crew Training Manual, dated June 30, 2023, provided, in part, 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...*

## **8.3 Flare and Touchdown**

The Boeing 767 Flight Crew Training Manual, dated June 30, 2023 provided, in part, 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 constant 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...*

## **8.4 Speed Brakes**

The Boeing 767 Flight Crew Training Manual, dated June 30, 2023, provided, in part, the following guidance about the speed brakes:

*The speedbrakes spoil the lift from the wings, which places weight on the main landing gear, providing excellent brake effectiveness. If the speedbrakes are not raised after touchdown, braking effectiveness may be reduced initially as much as 60%, since very little weight is on the wheels and brake application may cause rapid antiskid modulation...*

*The speedbrake can be fully raised after touchdown while the nose wheels are lowered to the runway with no adverse pitch effects. Normally, speedbrakes are armed to extend automatically. Both pilots should monitor automatic speedbrake extension after touchdown. In the event auto extension fails, the speedbrakes need to be manually extended. After touchdown, fly the nose wheels smoothly to the runway while slowly raising the speedbrake to the up position...*

## **9.0 Additional Information**

### **9.1 Rapid Derotation**

The My Boeing Fleet website had a video titled "Airplane Derotation" that was created by The Boeing Company Flight Operations Safety in 2001. The video provided information on the portion of a landing following main landing gear touchdown and nose gear touch down. The video described various reason that could result in a "hard nose gear contact." Those reasons included: Moderate/high Crosswinds, Non-Stabilized Approach, Speed brakes Not Armed, Bounce After Initial Touchdown, and/or Excessive Nose Down Elevator Input. The video further provided that one or more of the reasons mentioned above could result in a "hard nose gear contact." It further went on to provide that heavy manual braking or heavy braking due to a high autobrake setting may require more back pressure to reduce the derotation rate. It

then provided that after touchdown the crew should make sure the speed brakes deployed.

In addition there is a copy of the Boeing video available on YouTube.<sup>46</sup>

## 9.2 'Shocking' Touchdowns

The Flight Safety Foundation published an article<sup>47</sup> on August 12, 2011 regarding two accidents involving MD-11 aircraft. Although a different aircraft type than the accident airplane, the article described the initiating events in those accidents. Below is an excerpt from that article:

*Rapid derotation also has been a factor in a number of MD-11 hard landing accidents, the NTSB said, citing the July 31, 1997, FedEx accident in Newark, New Jersey, U.S., in which the captain "initiated a rapid nose-down elevator input within 0.5 second following initial touchdown, resulting in a second touchdown that exceeded the airplane's design structural limits."<sup>48</sup>*

*In the June 7, 2005, accident involving a UPS MD-11 in Louisville, Kentucky, U.S., the pilot "moved the control column forward sharply following the initial touchdown, reducing pitch angle from 5 degrees nose up to 1 degree nose down in 1.5 seconds," the NTSB said. The subsequent touchdown on the nosewheel was measured at 2.5 g.*

*As a result of its investigation of the Newark accident, the NTSB recommended in 2000 that the FAA establish a government-industry task force to develop a pilot training tool including a syllabus for simulator training in stabilized approaches, and techniques for recognizing and recovering from high sink rates, overcontrol in pitch and premature derotation.*

*The FAA subsequently issued an appendix to Advisory Circular 120-71, "Standard Operating Procedures for Flight Deck Crew Members," and Flight Standards Information Bulletins for Air Transport (FSATs) 00-08 and 00-12 to discuss stabilized approaches and reduction of approach and landing accidents.*

*"Despite the corrective action ... MD-11 crews continue to have difficulty in judging the flare maneuver and in making appropriate pitch and power*

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<sup>46</sup> Source: [Airplane Derotation \(youtube.com\)](http://Airplane%20Derotation%20(youtube.com))

<sup>47</sup> Source: ['Shocking' Touchdowns - Flight Safety Foundation](#)

<sup>48</sup> The article referenced the following in a footnote: "NTSB. Accident Report no. DCA97MA055. July 31, 1997. 'The flight crew and three other FedEx employees received minor injuries in the crash or while exiting the airplane through a cockpit window to escape from a fire that destroyed the airplane. The NTSB said the probable cause of the accident was the captain's overcontrol of the airplane during the landing and his failure to execute a go-around from a destabilized flare.'"

*changes after hard landings,” the NTSB said. “The frequency of MD-11 hard landing accidents suggests that generic guidance on these concepts is not sufficient or effective.”*

*The NTSB said that “enhanced operational guidance and recurrent training will provide near-term improvements that reduce the risk of MD-11 landing accidents,” while the board continues to identify and evaluate factors that contribute to the accidents.*

## **10.0 FAA Guidance**

### **10.1 Advisory Circular 25-7C**

Advisory Circular 25-7C “Flight Test Guide for Certification of Transport Category Airplanes,” Section 19 “Landing” c (3), dated October 16, 2012 provided guidance, in part, as to nose gear de-rotation to preclude an excessive nose gear touchdown rate so that the requirements of §25.125(b)(4) and (5) were met. The guidance stated that “nose gear touchdown rates in the certification landing test should not be greater than eight feet per second.”

### **10.2 CFR 25.125 Landing**

Title 14 CFR Part 25.125 provided, in part, the following airplane certification regulation:

*(b) In determining the distance in paragraph (a) of this section:*

*(1) The airplane must be in the landing configuration.*

*(2) A stabilized approach, with a calibrated airspeed of not less than  $V_{REF}$ , must be maintained down to the 50-foot height.*

*...*

*(4) The landing must be made without excessive vertical acceleration, tendency to bounce, nose over, ground loop, porpoise, or water loop.*

*(5) The landings may not require exceptional piloting skill or alertness.*

### **10.3 FAA Flying Handbook**

The FAA Airplane Flying Handbook (FAA-H-8083-3C), Section 9 “Approaches and Landings” provided, in part, the following guidance on landings and touchdown, although it should be noted that the landing technique described was aimed at non-transport category aircraft:

#### **Touchdown**

*The touchdown is the gentle settling of the airplane onto the landing surface. The round out and touchdown are normally made with the engine idling. During the*

*round out, the airspeed decays such that the airplane touches down on the main gear at or just above the approximate stalling speed. As the airplane settles, proper landing attitude is attained by application of whatever back-elevator pressure is necessary...*

*After the main wheels make initial contact with the ground, back-elevator pressure is held to maintain a positive AOA for aerodynamic braking and to hold the nose-wheel off the ground as the airplane decelerates. The pilot should be certain not to inadvertently have brake pressure engaged as touchdown occurs. Early use of brakes can result in a sudden drop in the nose and a loss of aerodynamic braking. As the airplane's momentum decreases, back-elevator pressure is gradually relaxed to allow the nose-wheel to gently settle onto the runway...*

## **11.0 Previous De-rotation Accidents**

In a review of the NTSB's investigations and assisted international investigations, six similar landing accidents involving Boeing 757/767 aircraft were discovered. 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
- May 22, 2002 - Monarch Airlines in Gibraltar
- April 20, 2009 - Royal Air Maroc flight 200 in New York, New York<sup>49</sup>
- August 18, 2019 - Delta Air Lines 414 in Ponta Delgada, Portugal

For three of the accident listed above, the NTSB stated *"Each accident occurred when the pilots applied large nose-down control column deflections after MLG touchdown, which resulted in large nose-down pitch rates and high vertical velocities at the nose gear. The combination of vertical velocity and pitch rate at nose-gear contact resulted in compression loads that exceeded the design loads of the forward fuselage crown structure."*<sup>50</sup>

## **12.0 NTSB Recommendations on De-rotation Accidents**

Recommendation A-94-118

*Require that all FAA-approved Boeing 757/767 Operating Manuals, and other airplane model Operating Manuals as deemed appropriate, clearly communicate de-rotation techniques and the potential for excessive pitch rates*

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<sup>49</sup> Source: DCA09FA045 [NTSB Docket - Docket Management System](#)

<sup>50</sup> Source: [Crash During Landing Federal Express, Inc. McDonnell Douglas MD-11, N611FE, Newark International Airport, Newark, New Jersey, July 31, 1997 \(ntsb.gov\)](#)

*after touchdown if pilots use large nose-down control column deflections. Such information should be inserted in the sections of the manual that refer to normal and crosswind approach and landing, as a cautionary note. Instructions calling for positive forward control pressure after nose wheel touchdown should be replaced with a warning to smoothly fly the nose wheel to the runway by relaxing aft control column pressure and not to use full down elevator. **Closed - Acceptable Alternate Action***

Recommendation A-94-119

*Modify initial and recurrent Boeing 757/767 pilot training programs, and other airplane model pilot training programs as deemed appropriate, to include discussion of de-rotation accidents. **Closed - Acceptable Action***

## **E. LIST OF ATTACHMENTS**

- Attachment 1 - Flight Crew Written Statement
- Attachment 2 - Instructor Pilot Interview Transcript
- Attachment 3 - Flight Attendant Irregular Operations Report [Excerpt]
- Attachment 4 - Flight Crew Training Records [Excerpts]
- Attachment 5 - Flight Crew Trip Pairing and Schedules
- Attachment 6 - Accident Flight Plan and Weather Packet
- Attachment 7 - Accident Flight ACARS Data [Excerpts]
- Attachment 8 - IAH Jeppesen Charts [Excerpts]
- Attachment 9 - United Airlines 757-767 Flight Manual [Excerpts]
- Attachment 10 - The Boeing Company Speed Brake Lever Assembly Guidance [Excerpts]
- Attachment 11 - The Boeing Company 767 Flight Crew Training Manual [Excerpts]
- Attachment 12 - Simulator Evaluation
- Attachment 13 - Flight Safety Foundation 'Shocking' Touchdown
- Attachment 14 - Operational Factors Group Member Party Forms

Submitted by:

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