

DCA23LA384

# **OPERATIONAL FACTORS**

Attachment 12  
Simulator Evaluation

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## **SIMULATOR EVALUATION**

**Location:** United Airlines Training Center, Denver CO  
**Date:** February 13, 2024  
**Time:** 1000 MST  
**Aircraft:** B-767-300 simulator FAA ID #680  
**Airport:** Houston Intercontinental Airport (KIAH), Houston, TX

### **Overall Objective:**

- Documentation of indications and handling characteristics compared to a more known condition.
- Document procedures for Arming the Speed Brakes
- Document all indications and Speed Brake Lever position.
- Document any control force required to overcome pitching motion using terms such as "lighter," "heavier," "normal," etc.

### **Invited Participants:**

Brice Banning (IIC)  
Shawn Etcher (NTSB, Operations)  
Michael Brown (NTSB, Air Traffic Control)  
Todd Gentry (FAA)- unable to attend.  
Ryan Hurling (UAL)  
Steve Demko (ALPA)  
Mark Diaz (Boeing)

### **Initial Simulator Setup for the Test Runs:**

- DOOBI intersection (DOOBI2 RNAV Arrival)
- Altitude 15000 feet
- Speed 250 kts
- Configuration:
  - Landing Weight 285,270 lbs.
  - Landing Fuel 16,000 lbs.
  - % MAC 23.5<sup>1</sup>
  - Outside temperature on ground 33°C, Dewpoint 21°C
  - V-speeds associated with above weight Vref - 137, Target speed - standard FO noted 143.
  - Flaps 30
  - Autobrake 2
- Cloud heights: Scattered at 5,000 ft. agl.
- Weather:
  - Wind: 230 @5 is reported FO stated some gusts but not

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<sup>1</sup> At departure weight of 317,730 lbs. and considering a fuel burn of 32,100 lbs. the %MAC likely changed.

quantified.

- Visibility 10 SM
- Altimeter 30.12

- **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**

- Day
- Fuel freeze to be utilized during the entire simulator evaluation to repetitively simulate the accident flight's weight near the time of the accident.
- All approaches and landings will be conducted on runway 26L unless otherwise noted.
- Autothrottles engaged until 300 feet.
- Thrust Reversers will be used after main wheel touch down unless otherwise noted. (attempt to keep nose wheel off the ground) Aft Pressure per FO statement to "prevent nose wheel from 'hitting the runway.'
- All runs were conducted with motion **on** unless noted otherwise.
- All subsequent runs will be set up the same as the first run or with the concurrence of all closer to the runway but no less than 5 miles.
- All runs, unless noted, will be flown from the right seat.
- All runs to be repeated as necessary and note attempt number.

**Prior to starting any runs:**

- Photo document from left seat point of view (POV) speed brake lever setting in Stowed, Armed, Deployed.
- Photo document from right seat POV speed brake lever setting in Stowed, Armed, Deployed.
- Photo document any indications/cautions/warnings of speed brake lever deployed below 300 feet and armed.
- Document speed brake lever length from top of center pedestal to the top of the lever when in DOWN, and ARMED positions. Measurements were taken from the tape resting on the control stand to the bottom of the labeled grip attached to the speed brake lever.
  - DOWN 3 3/16th inches
  - ARMED 3 9/16th inches.



**Figure 1:** View of Speed Brake Lever in "DOWN" position from Left Seat



**Figure 2:** View of Speed Brake Lever in "DOWN" position from Right Seat



**Figure 3:** View of Speed Brake Lever in "ARMED" position from Left Seat



**Figure 4:** View of Speed Brake Lever in "ARMED" position from Right Seat.

## Run 1: Normal RNAV Arrival, Approach, and Landing Runway 26L.

### Procedure

- Place aircraft at the DOOBI intersection.
- Set up for normal ILS 26L approach.
- Normal approach and landing procedures
  - Allow for acclimation of normal procedures and indications.
  - **NO** turbulence
- Allow airplane and autopilot to stabilize prior to release.
- Disengage autopilot approximately 1,000 ft agl<sup>2</sup> but no later than limitations.
- Note and photo document any, if any, and all indications and alerts
- Disconnect autopilot and note indication and audible alerts (flight freeze if needed to document)
- Note any control forces needed after the autopilot was disconnected.
- After touchdown deploy thrust reversers as normal operations.
- Continue arrival and assess the handling characteristics of the airplane.
- Photo document any indications of speed brake deploy.
- Stop run when airplane at full stop on runway.

### Specific items to note.

- Photo document the following:
  - Indication on EICAS prior to disengagement of autopilot
  - Control force feel.
  - Handling characteristics
  - Position of Speed Brake Lever on approach
  - Max Pitch Attitude approximately 2.5° nose up during the approach and approximately 5.0 ° nose up during the landing flare<sup>3</sup>.

### Notes

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<sup>2</sup> Per captain statement FO disengaged at 1000 ft and went "slightly high" on the PAPI.

<sup>3</sup> For the purpose of this report landing flare is defined as the time following the automatic 50 ft audible alert generated by the radio altimeter.

a. Aircraft indications noted: no indications noted.

b. Aircraft indications noted **AFTER** autopilot disengaged: no indications noted.

Of Note: the speed brake was armed when the landing gear was extended. The FO, who was the pilot flying, leaned slightly forward, due to the position of the thrust levers partially blocking the markings, and visually verifying the speed brake lever was armed. During landing simulator computers displayed an aft control column movement.

### **Run 2: Normal Arrive with Speed Brake Lever in DOWN position.**

- Place aircraft on approximate 6 mile final at 3,000 feet.
- Set up for normal ILS 26L approach.
- Normal approach and landing procedures
  - Allow for acclimation of normal procedures and indications.
  - **NO** turbulence
- Allow airplane and autopilot to stabilize prior to release.
- Disengage autopilot approximately 1,000 ft agl but no later than limitations.
- Note and photo document any, if any, and all indications and alerts
- Disconnect autopilot and note indication and audible alerts (flight freeze if needed to document)
- Note any control forces needed after the autopilot was disconnected.
- Continue arrival and assess the handling characteristics of the airplane.
- Hold nose wheel off the ground after touchdown and deploy thrust reversers.
- Photo document any indications of speed brake deploy.
- Stop run when airplane at full stop on runway.

### **Specific items to note.**

- Photo document the following:
  - Indication on EICAS prior to disengagement of autopilot
  - Control force feel.
  - Handling characteristics
  - Position of Speed Brake Lever on approach
  - Max Pitch Attitude 2.5° nose up on approach and slightly less than 5.0° nose up during the landing flare.

## Notes

- c. Aircraft indications noted: none noted.
  
- d. Aircraft indications noted **AFTER** autopilot disengaged: none noted.

Of note: when the thrust reversers were unlocked the speed brake lever moved from down to armed position, once thrust reversers were deployed the speed brake lever moved to UP, as expected, with no other pilot input. From activation of the thrust reversers to the speed brake being fully deployed was about 2 seconds<sup>4</sup>.

### **Run 3A - Normal Arrival with Speed Brake Disarmed (Speed Brake Lever in DOWN position) with Aggressive Control Column input.**

- Place aircraft on an approximately 6 mile final and 3,000 feet.
- Set up for normal ILS 26L approach.
- Normal approach and landing procedures
  - Allow for acclimation of normal procedures and indications.
  - **NO** turbulence
- Allow airplane and autopilot to stabilize prior to release.
- Disengage autopilot approximately 1,000 ft agl but no later than limitations.
- Note and photo document any, if any, and all indications and alerts
- Disconnect autopilot and note indication and audible alerts (flight freeze if needed to document)
- Note any control forces needed after the autopilot was disconnected.
- Continue arrival and assess the handling characteristics of the airplane.
- Photo document any indications of speed brake deploy.
- Stop run when airplane at full stop on runway.

### **Specific items to note.**

- Photo document the following:
  - Indication on EICAS prior to disengagement of autopilot
  - Control force feel.
  - Handling characteristics
  - Position of Speed Brake Lever on approach.

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<sup>4</sup> Thrust Revers and the speed brakes are mechanically connected, the thrust levers moving into revers will mechanically lift the speed brake lever from the down detent into the armed detent by mechanical link.



- Max Pitch Attitude 2.5° nose up during the approach.
- To achieve aggressive inputs the pilot flying on touchdown increase pitch, aggressively de-rotated the airplane with forward column movement, then applied aft control column pressure after the nose wheel “bounced.” During 2<sup>nd</sup> de-rotation the thrust reversers would be activated.

#### Notes

- e. Aircraft indications noted: none noted.
- f. Aircraft indications noted **AFTER** autopilot disengaged: none noted.

Of note: Max Pitch Attitude 2.5° nose up during the approach, during landing 28 lbs. of force was applied aft on the control column which equated to 38% airplane nose up (ANU).

With thrust reverser activation the speed brakes deployed normally. However, it was noted that the autobrakes were slightly delayed in activating.

### Run 3B - Normal Arrival with Speed Brake Disarmed with Aggressive Control Column input.

- Place aircraft on an approximately 6 mile final and 3,000 feet.
- Set up for normal ILS 26L approach.
- Normal approach and landing procedures
  - Allow for acclimation of normal procedures and indications.
  - **NO** turbulence
- Allow airplane and autopilot to stabilize prior to release.
- Disengage autopilot approximately 1,000 ft agl but no later than limitations.
- Note and photo document any, if any, and all indications and alerts
- Disconnect autopilot and note indication and audible alerts (flight freeze if needed to document)
- Note any control forces needed after the autopilot was disconnected.
- Continue arrival and assess the handling characteristics of the airplane.
- Photo document any indications of speed brake deploy.
- Stop run when airplane at full stop on runway.

### Specific items to note.

- Photo document the following:
  - Indication on EICAS prior to disengagement of autopilot
  - Control force feel.
  - Handling characteristics
  - Position of Speed Brake Lever on approach might need to measure as above if able to get it close to ARMED but not actually armed.
  - Max Pitch Attitude 2.5° nose up during the approach.
  - To achieve aggressive inputs the pilot flying on touchdown increase pitch, aggressively de-rotated the airplane with forward column movement, then applied aft control column pressure after the nose wheel “bounced.” During 2<sup>nd</sup> de-rotation the thrust reversers would be activated.

#### Notes

g. Aircraft indications noted: none noted.

h. Aircraft indications noted **AFTER** autopilot disengaged: none noted.

Of note: Aft pressure applied to control column, then the nose was aggressively de-rotated. Once the nose “bounced” aft control column applied, then forward pressure applied and nose de-rotated, auto brakes engaged exacerbating the de-rotation. The thrust reversers were deployed, speed brake deployed as expected.

### Run 3C - Normal Arrival with Speed Brake Disarmed with Aggressive Control Column input.

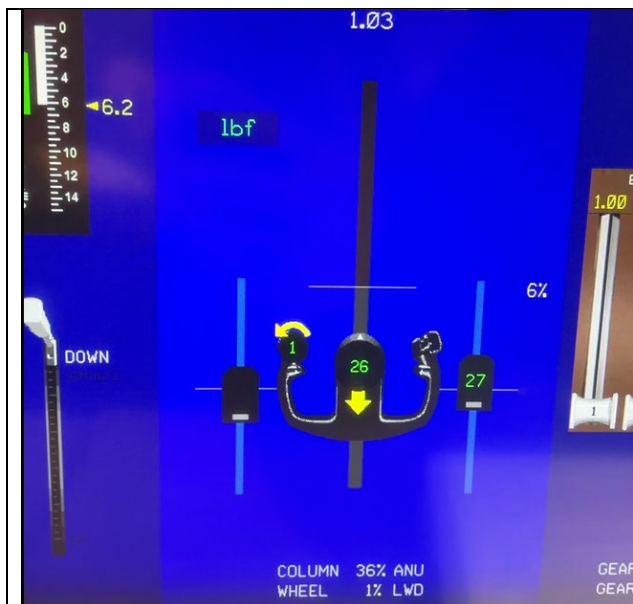
- Pilot Flying was in the Left seat.
- Place aircraft on an approximately 6 mile final and 3,000 feet.
- Set up for normal ILS 26L approach.
- Normal approach and landing procedures
  - Allow for acclimation of normal procedures and indications.
  - **NO** turbulence
- Allow airplane and autopilot to stabilize prior to release.
- Disengage autopilot approximately 1,000 ft agl but no later than limitations.
- Note and photo document any, if any, and all indications and alerts
- Disconnect autopilot and note indication and audible alerts (flight freeze if needed to document)

- Note any control forces needed after the autopilot was disconnected.
- Continue arrival and assess the handling characteristics of the airplane.
- Photo document any indications of speed brake deploy.
- Stop run when airplane at full stop on runway.

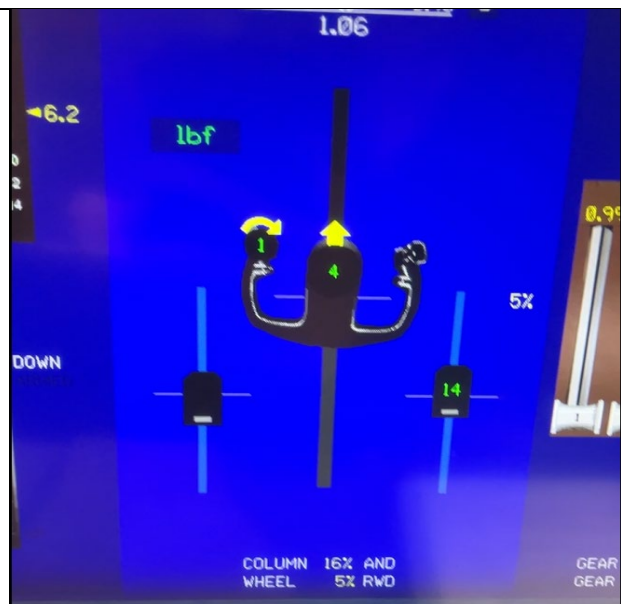
**Specific items to note.**

- Photo document the following:
  - Indication on EICAS prior to disengagement of autopilot
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  - Position of Speed Brake Lever on approach might need to measure as above if able to get it close to ARMED but not actually armed.
  - Max Pitch Attitude 2.5° nose up during the approach.
  - To achieve aggressive inputs the pilot flying on touchdown increase pitch, aggressively de-rotated the airplane with forward column movement, then applied aft control column pressure after the nose wheel “bounced.” During 2<sup>nd</sup> de-rotation the thrust reversers would be activated.

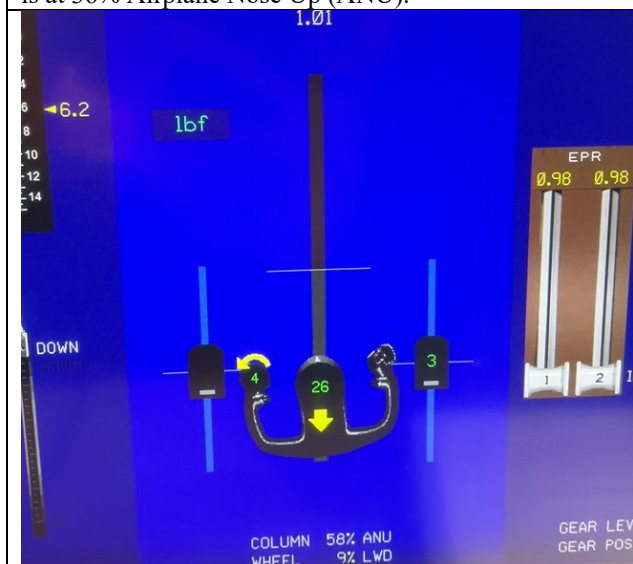
<b>Notes</b>
<p>i. Aircraft indications noted: none noted.</p> <p>j. Aircraft indications noted <b>AFTER</b> autopilot disengaged: none noted.</p> <p>Of note: More aggressive de-rotation was done with the rapid application of forward pressure being applied on the left seat control column. The nose of the airplane “bounced,” and the nose immediately become airborne, with the main landing gear indicating on the simulator control consol of becoming airborne. The action resulted in a pilot induced oscillation similar to what was indicated on the FDR data before the airplane could be stopped on the runway. This run very closely replicated the accident sequence as indicated on the FDR data. The following screen shots were of the control column movement during the oscillation and the position of the speed brake lever. All screen shots below are following main landing gear touch down.</p>



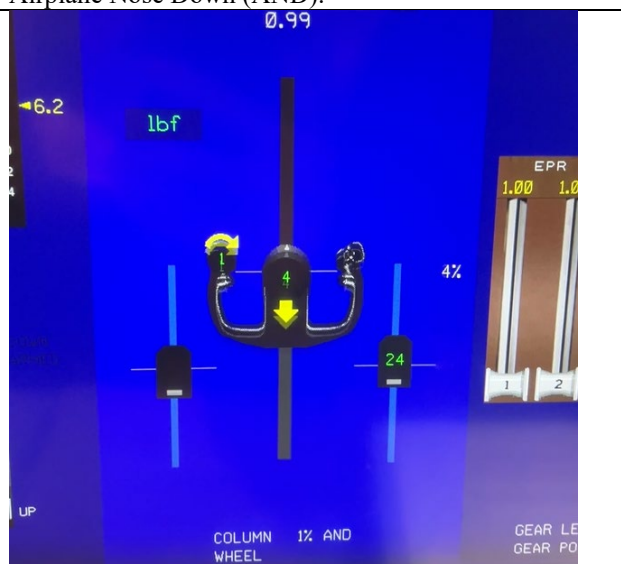
**Figure 5:** Control Column in lbs. of force (26 lbf) with speed brake lever in "Down" position. Column position is at 36% Airplane Nose Up (ANU).



**Figure 6:** Control Column at 4 lbf with speed brake lever in "Down" position. Column position is at 16% Airplane Nose Down (AND).



**Figure 7:** Control Column at 26 lbf with speed brake lever in "Down" position. Column position is at 58% ANU.



**Figure 8:** Control Column at 4 lbs. with speed brakes deployed in the "UP" position. Column position is at 1%AND.