Republic of Lebanon

Ministry of Public Works & Transport

Final Investigation Report

DHL - ES 160 – B767-300
A9C - DHAB

18th September 2023

BRHIA (OLBA) - Lebanon

Presented by the IIC on 18th September 2025

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Ministry of Public Works & Transportation

Beirut
Lebanon

18th September 2025

His Excellency Mr. Fayez Rassamny, Minister of Public Works & Transportation

Dear Mr. Minister,

I have the honor to submit the report on the circumstances of the accident to the DHL 160 flight, a Boeing 767-300, registration A9C-DHAB, that sustained structural damage during landing on runway 16 at Beirut Rafic Hariri International Airport on 18 September 2023.

Yours sincerely,

Captain Mohammed Aziz
Investigator In Charge

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FOREWORD

Lebanon is a signatory to the Convention on International Civil Aviation (Chicago 1944) and a founding member of the International Civil aviation Organization (ICAO). In line with Article 26 of the Convention, the Lebanese Government launched an investigation into the accident that occurred to DHL flight 160 (ES 160), a Boeing 767-300 type aircraft registered A9C-DHAB. An Investigation Committee (IC) and an Investigator in Charge (IIC) were appointed by the Lebanese Minister of Public Works & Transportation. The State of Registry/Operator and the State of Manufacturer were both invited to appoint accredited representatives to the IC.

A Preliminary Report was presented to the Lebanese Government on October 18, 2023. The final draft report was presented as a confidential document to HE the Lebanese Minister of Public Works and Transportation on 18th August 2024 and circulated to all parties (the NTSB -USA, GCAA - Bahrain) for comments, as per ICAO Annex 13 requirements. The comments were received in due time and discussed with all parties prior to the issue of this final report.

In accordance with Annex 13 to the Convention and with the Lebanese Air Regulations (LAR), the investigation has not been conducted so as to apportion blame, or to assess individual or collective responsibility.

Consequently, the sole objective of this investigation into the accident of ES 160 is to establish what happened, to analyze how and why the occurrence took place, and from this analysis to determine what the occurrence reveals about the safety health of the aviation system. Such information is used to arrive at conclusions and make safety recommendations aimed at drawing lessons from what happened in order to prevent similar reoccurrences, and where appropriate, to increase the overall safety of the aviation system.

Furthermore, the use of this report for any purpose other than for the prevention of future accidents could lead to erroneous interpretations.

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List of Appendices

Glossary

AOG	Aircraft on Ground
ASI	Air Safety Investigator
BEA	Bureau d'Enquêtes et d'Analyses (France)
BRHIA	Beirut Rafic Hariri International Airport
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
FCL	Flight Crew Licensing
FCOM	Flight Crew Operating Manual
FCTM	Flight Crew Training Manual
FMC	Flight Management Computer
F/O	First Officer
Ft	Feet
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
Knots (Kt)	Nautical Miles per hour
LARs	Lebanese Air Regulations
LDGCA	Lebanese Directorate General of Civil Aviation
MAC	Mean Aerodynamic Chord
MEL	Minimum Equipment List
METAR	Meteorological Airport Report
NM	Nautical Mile
NOTAM	Notice to Air Men
NTSB	National Transportation Safety Board (USA)
OBBI	Bahrain International Airport
OLBA	Beirut Rafic Hariri International Airport
OMA	Operations Manual Part A
PF	Pilot Flying
PIC	Pilot in Command
PM	Pilot Monitoring
P/N	Part Number
S/N	Serial Number
STD	Scheduled Time of Departure
TAF	Terminal Area Forecast
UTC	Universal Time Coordinated
VHF	Very High Frequency
Z	Universal Time Coordinated

Synopsis

Date of accident
18th September 2023 at 16:09[1]

Aircraft
Boeing 767-300

registered A9C-DHAB

Site of accident
OLBA - Lebanon

Owner
Cargo Aircraft Management INC

Type of flight
Scheduled Cargo

Operator
DHL Aviation EEMEA B.S.C.

Persons on board

Flight crew: 2
Other: 1

Summary

On 18 September 2023, at 13:13 UTC, A9C-DHAB took off from Bahrain International Airport to Beirut Rafic Hariri International Airport (Lebanon) on a scheduled flight as ES 160. At 16:09 UTC (19:09 LT) it made a hard derotation during landing on runway 16 at destination resulting in severe structural damage.

Consequences

	People			Equipment
	Killed	Injured	Unhurt	Severe structural damage
Crew	Nil	Nil	2	
Passengers	Nil	Nil	1	
Third parties	Nil	Nil	Nil	

(1) All times in this report are UTC, except where otherwise specified. Three hours should be added to obtain the local time applicable in Lebanon on the day of the accident.

Executive Summary

On 18 September 2023 a DHL Cargo scheduled flight from Bahrain International Airport (OBBI) to Beirut Rafic Hariri International Airport (OLBA) carried out a stabilized approach on runway 16 at destination and landed at 1609 UTC (1909 LT). The landing was identified by the crew as a “hard landing”.

The aircraft taxied to its parking position. Maintenance detected serious structural damages grounding the aircraft as AOG (Aircraft On Ground).

Three people were on board the aircraft, The Captain, the First Officer (F/O), who was the Pilot Flying (PF), and an Engineer who was sitting in the cockpit during landing. None was injured.

The Cockpit Voice Recorder (CVR) and the Digital Flight Data Recorder (DFDR) were both retrieved and read at the BEA facility at Le Bourget, France. The quality of data was excellent; however, the CVR Circuit Breaker was not pulled following the landing and the aircraft electric system remained powered, thus overriding the accident time by 52 minutes and depriving the investigation from valuable information on communication inside the cockpit, prior, during and immediately following the event.

Data from the DFDR revealed that the aircraft main wheels touched down normally on ground but this was followed by a swift and continued nose down input on the flight control resulting in a hard derotation that damaged the aircraft structure.

The reoccurrence of this type of accident on the Boeing 767-300 has been discussed within this report with an overview of previous recommendations that were implemented.

Organization of the investigation

On Monday 18th September 2023, the Lebanese DGCA was informed that a DHL Boeing 767-300 type aircraft experienced a hard landing and was grounded.

After having established without doubt that the airplane had suffered structural damage, the Lebanese Authorities launched a technical investigation. In accordance with Annex 13 to the Convention on International Civil Aviation and the Lebanese Air Regulations (LARs) Part X - Aviation Accident and Incident Investigation, a team from Lebanese investigators was formed by a ministerial decree from the Minister of Public Works and Transport to lead the technical investigation. The Bahrain authority (State of Registration and Operator) and the NTSB (State of Manufacture) were notified of the accident and invited to nominate their accredited representatives. ICAO was also notified. The decree is appended to this preliminary report as Appendix 1).

Following the existence of a Memorandum of Understanding between France and Lebanon, the French Bureau d'Enquêtes et d'Analyses (BEA) was contacted to assist the Lebanese authorities to read the CVR and the DFDR.

The investigation team composition was as follows:

Captain Mohammed Aziz (ASI Expert), IIC
Dr. Omar Kaddouha (DGCA - Fight Safety)
Mr. Ayad Bechara (DGCA – Airworthiness)
Captain Charbel Girgis (ASI – Flight Operation)
Mr. John Lovell (NTSB – USA Accredited Representative)
Captain Raoof Abdelaziz Alalawee – (Bahrain Accredited Representative)

Three working groups were formed as follows:

- Operations
- Engineering, Maintenance & Structure
- Flight Recorders

The CVR and DFDR were read at the BEA facilities at Le Bourget, Paris, France. Both recorders reading was performed by BEA personnel in association with and under the supervision of the IIC, DGCA Flight Safety and DHL Director Safety and Ground Operations, Technical Advisor to the Bahrain Accredited Representative (Refer to Appendix 2 BEA Report).

1. FACTUAL INFORMATION

1.1 History of Flight

On 18 September 2023 at 13:13, the accident airplane, a Boeing 767-300 BDSF registration A9C-DHAB, departed Bahrain International Airport (BIA - OBBI) as ES 160 to Beirut Rafic Hariri International Airport (BRHIA - OLBA), Lebanon. The following history of flight is reproduced from verified data retrieved from the aircraft DFDR in addition to information from the Flight Crew and the engineer present on board.

The aircraft was dispatched under MEL item 27-62-01-02 “Flight Controls, Auto Speed Brake System”. The Flight Crew reported they discussed implication of the MEL, and while the Captain (PM) had previously informed the F/O (PF) that he would deploy the speed-brake as per procedure, he agreed with the PF’s request to operate the speed-brake handle after landing. The PF stated that he had done this previously and was comfortable with the procedure for manual deployment. The use and manner of deployment of the speed-brake was discussed further before take-off and at the top of descent briefing, where the Captain emphasized again to the PF to “deploy the speed-brake slowly”.

An engineer was onboard to attend maintenance duties on ground during the transit stop in Beirut. The engineer sat during landing in the observer seat, positioned directly behind and between the two pilots’ seats.

The DFDR indicates that the flight was uneventful till reaching the landing phase at BRHIA. It shows that the aircraft was fully configured for a flaps 25 landing at 1,423 feet RA and that the approach was stable all the way till 20 feet. At that altitude the rate of descent recorded on the DFDR shows – 650 ft/minute with a Vref +4.5 kts. The main gear touchdown was normal with the left gear touching down first then one second later the right main landing gear touchdown at 16:08:15 UTC. Following the main gear touchdown, the acceleration recorded + 1.352 G. The nose gear touchdown occurred after 1.5 seconds and resulted in a recorded + 1.771 G.

Then the DFDR records that the nosewheel air/ground went from “ground” to “air” to “ground” within one second followed by a recorded acceleration of + 1.908 G (forces measured from the accelerometer in the main wheel well). This coincided with the time the speed brakes were manually extended by the F/O (PF). In parallel the DFDR shows the elevator input increase from +5.8 deg to + 11.1, then within one second to -18.3 deg followed by -20.6 deg and stayed in that position for 19 seconds. Following that, the elevator input returned gradually to neutral, the aircraft vacated the runway and the taxi-in was normal.

During the interview with the Flight Crew, the captain (PM) recalled that the aircraft “lurched up” and the nose wheel then slammed back down onto the runway, describing it as “horrendous” and that his headset and prescription glasses flew from his head and he reached his bag to get the second set of prescription glasses prior to take control of the aircraft. He estimated that the time lapse between the nose wheel final touchdown and the time he called “I have control” and took over the control of the aircraft to be “10-12 seconds”.

The F/O (PF) recalled during the interview that he pulled the speed-brake lever manually at what he considered “a normal rate”, an action he had done previously many times. Data from the DFDR confirms that the speed brakes were manually moved to full deployment at a similar speed had it been moved in auto. However, the F/O recalled that “as he leaned over to the left to reach the speed-brake lever, there was a slight left turn to the yolk” following which “the aircraft pitched up violently”, describing the column as “acting aggressively” and further stated that the whole episode happened too fast and that he was unable to take control of the control column as “it moved away from him”. He then confirmed that he kept his feet on the rudder pedals “to keep control of the aircraft on the center line” till the Captain called “I have control”. Following that call the Captain became in full control of the aircraft till reaching the parking stand. When asked about the time lapse between the nose wheel last touchdown and the Captain’s call he stated “a few seconds”. Both pilots stated that the nose wheel touched down “3 times”; however, the DFDR only recorded 2 times.

The engineer who sat in the observer seat, positioned directly behind and in between the pilots, recalled that “on touchdown the speed brake lever was extended manually by the F/O and the aircraft touched down and jumped high 2 or 3 times on the runway, after that the Captain took control of the steering and took off his headset, he told the F/O “I told you don’t extend the lever very fast “as I briefed you””. The engineer could not recall any specifics to establish who was in control of the aircraft prior to the Captain announcing “I have control” and when asked about the Captain’s hands position during the approach, he recalled “they were on his thighs and shadowing the controls at times”, however he felt “he did not have a clear view of pilot hand positions”.

The also reported that once on stand, the Captain was concerned about the state of the nose gear and instructed the F/O to call Maintenance Operations Control (MOC) and obtain information on how to retrieve a hard landing report from ACARS event printout. Both pilots and the engineer recalled that as a result of the event “the panel over the jump seat fell down, the escape reels fell down, water displaced out of toilet and coat hangers fell down”.

The engineer on board went down and conducted an inspection of the nose and main landing gears, as well as the engines. No damage was found. While still inspecting the landing gears, he was alerted by ground staff of a crinkle in the fuselage. The Engineer’s inspection of the fuselage detected wrinkled/buckled fuselage skin at STA 654 (between the wing forward section and aft of the Cargo Door) on both left and right side of the fuselage and top shell upper pressurized fuselage crown. (Refer to figure 1 & 2)

The cargo was off-loaded and no apparent damage to Cargo Door or cargo hold floor, nor any shifting of the load were noticed. The aircraft was declared unserviceable and was grounded at BRHIA.

The Lebanese DGCA representative came on board about an hour after the landing and informed the engineer that no communication or report was filed for an incident or accident and that they found out the aircraft was grounded through a worker at the airport. A report was eventually filled by the Flight Crew and submitted to the DGCA representative with copies of the pilots' licenses and medicals. No drug or alcohol test was administered and the CVR and DFDR CB were not pulled to preserve the data.

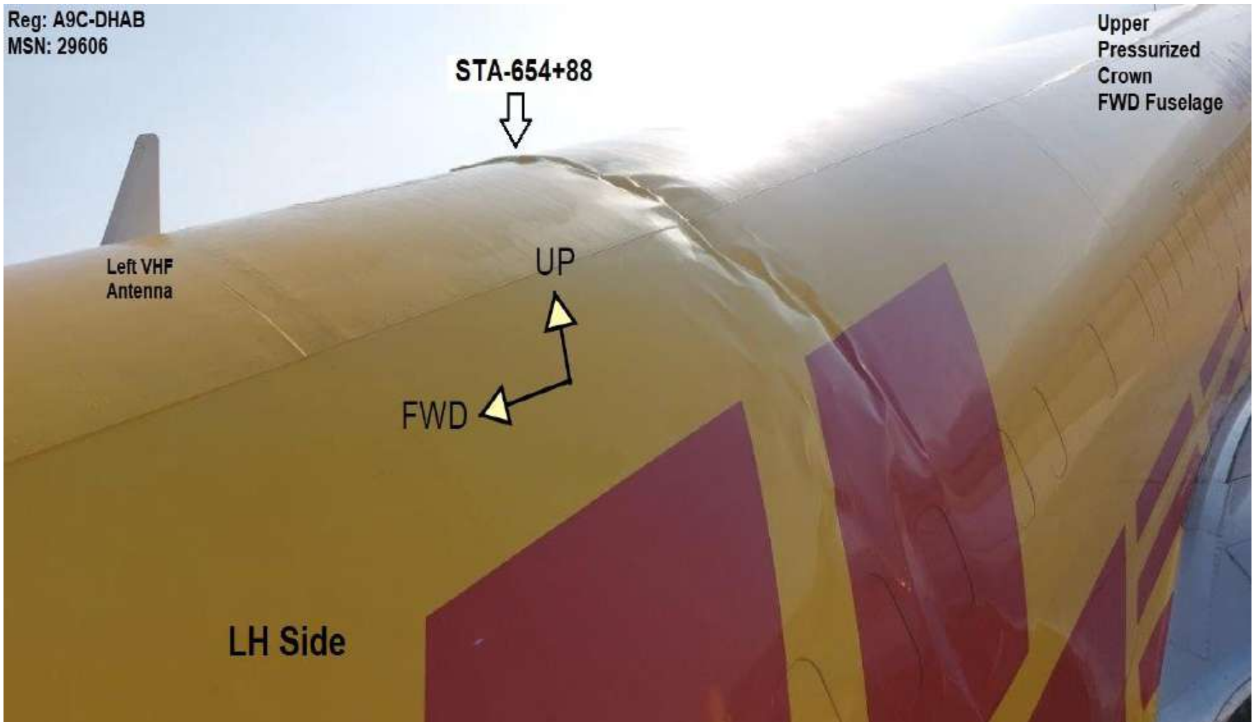


Figure 1: Top and LH side view of the damage to the fuselage

1.2 Injuries to Person

NIL

1.3 Damage to Aircraft

The aircraft fuselage suffered severe damage in the form of wrinkled/buckled fuselage skin at station 654 on both left and right-hand side and on the top shell pressurized fuselage crown. In addition, some oil traces were identified on the LH main landing gear (Figure 1 & 6 below).

Figure 2: LH Main Landing Gear oil traces

Below is the detailed position of the damage as received from the Boeing AOG team that inspected the aircraft: (Refer to Figures 1 above and 3 to 10 below)

- Skin panel +654 to 786 and STR-26L TO 17L
- Skin panel +654 to 786 and STR-17L TO 8L
- Skin panel +654 to 786 and STR-8L TO 2R
- Skin panel +654 to 786 and STR-2R TO 8R
- Skin panel +654 to 786 and STR-8R TO 17R
- Skin panel +654 to 786 and STR-17R TO 26R
- Stringers 21L to 17L
- Stringers 16L to 8L
- Stringers 7L to 1R
- Stringers 2R to 7R
- Stringers 8R to 16R
- Stringers 17R to 23R
- Shear ties and stringer Clips
- Frames detail, frame assembly
- Tubing, static lines
- Tubing, instrument lines
- Tubing, smoke detection, Main Deck Cargo
- Bracket assy, cargo ceiling liner support
- Bracket – ECS ducts Main Deck Car

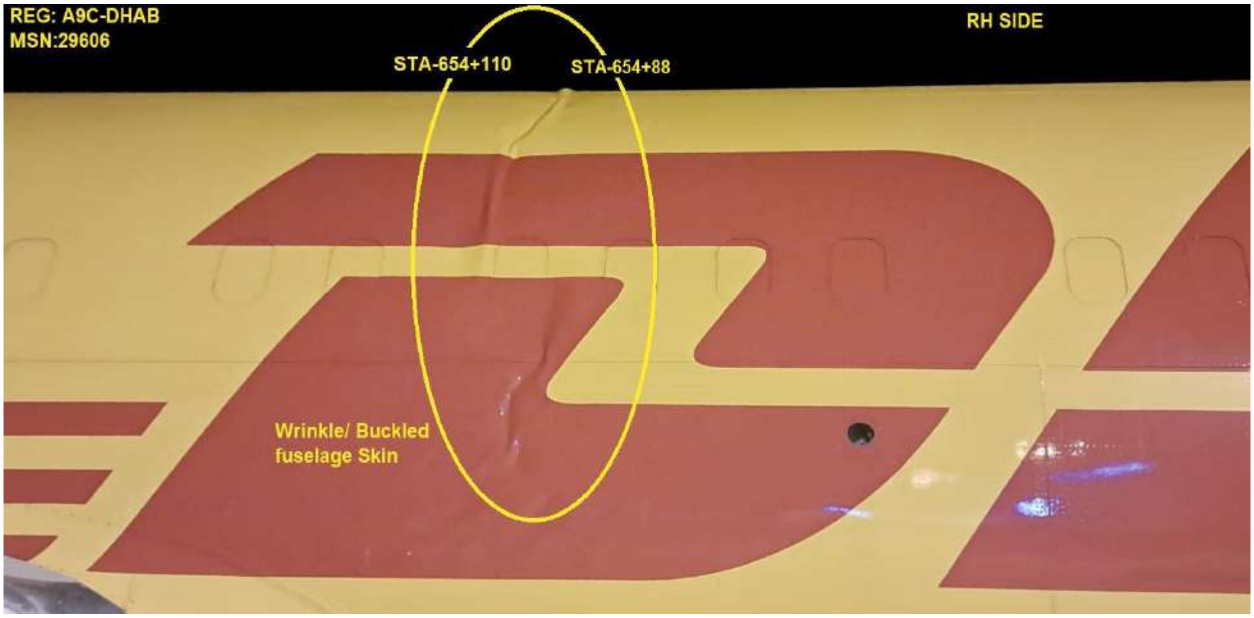


Figure 3: RH side view of the damage to the fuselage

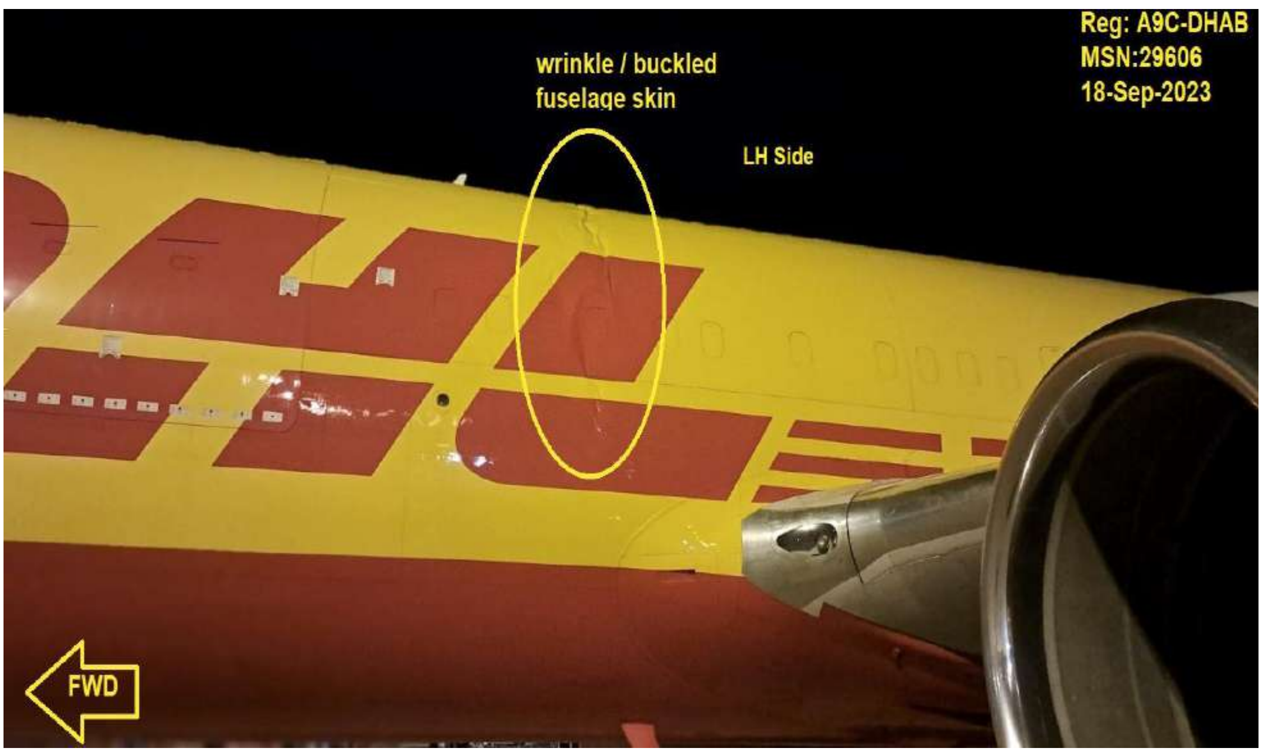


Figure 4: LH side view of the damage to the fuselage

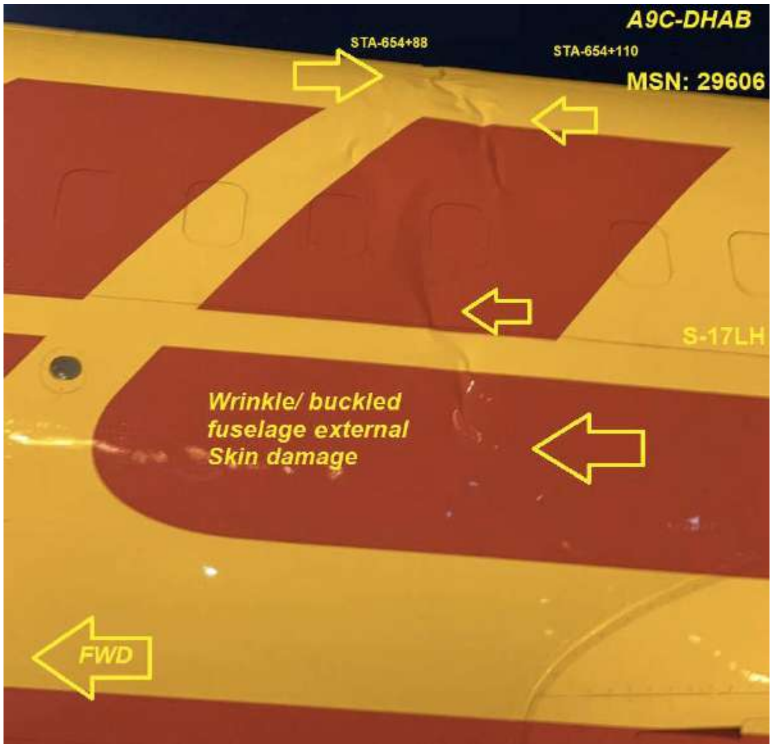


Figure 5: Wrinkle/buckled fuselage external Skin damage LH side enlarged view

Figure 6: Wrinkle/buckled fuselage Skin upper crown fuselage damage

Figure 7: Upper crown fuselage damage as seen from the inside

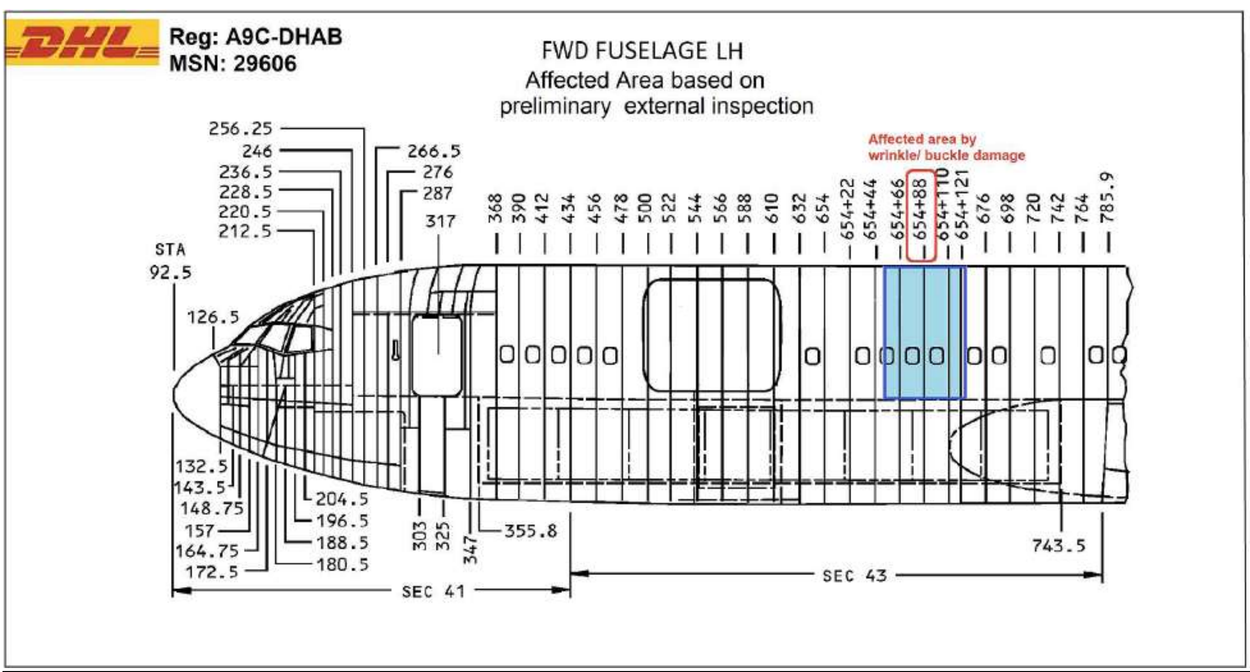


Figure 8: FWD fuselage LH affected Area

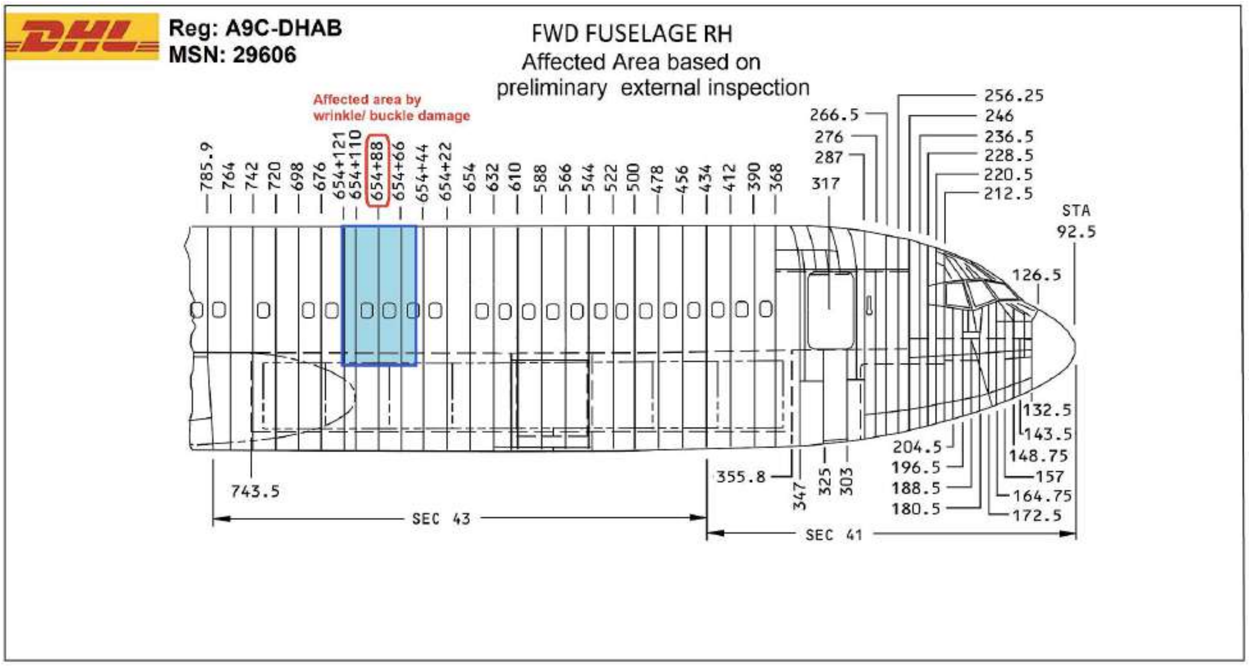


Figure 9: FWD fuselage RH affected Area

1.4 Other Damage

Nil.

1.5 Personnel Information

1.5.1 The Flight Crew

The flight crew consisted of a Captain and a First Officer, both holding an Air Transport Pilot License (ATPL) and properly certified to operate the Boeing 767-300 with many thousands of flying hours on that type of aircraft. They had enough rest prior to the flight to Beirut. The below table reflects the necessary information on the two pilots as received from DHL:

	Captain	First Officer
Age	61	32
Pilot License	ATPL	ATPL
Medical Expiry date	26/01/2024	18/06/2024
Total Flying Hours	22144 hrs.	4666 hrs.
Hours on type	7728 hrs.	3141 hrs.
Hours Last 90 Days	147:16 hrs.	68:07 hrs.
Hours on Duty Prior to Occurrence	3 hrs.	3 hrs.
Hours Off Duty Prior to Work Period	84:45 hrs.	84:45 hrs.
Date of joining DHL	1st April 2015	15th July 2017

1.5.2 The Engineer

DHL reported that the Engineer was onboard as part of the crew to attend to duties on ground for the transit flight. They explained that there is no engineering team at BEY and the engineer would normally be onboard the flight. The engineer was properly licensed, held a valid Aircraft Maintenance License and a valid Medical Fitness of Aircraft Maintenance Certifying Staff. He joined DHL on 1st August 2023.

1.6Aircraft information

1.6.1 Aircraft history

The aircraft was manufactured in the USA by Boeing in 1999, was registered in the US as N399AN, delivered to a US carrier and flew as a passenger aircraft till 2020 when it was converted to a Cargo aircraft. Following the conversion, it was acquired by Cargo Aircraft Management INC (CAM) and operated by DHL Air (UK) on October 14, 2021 and registered as G-DHLC. On June 26, 2023, it was transferred to and started operation by DHL International Aviation in Bahrain and registered as A9C – DHAB, still under the ownership of CAM.

The following table contains the aircraft information:

Manufacturer	Boeing Company
Type and model	B767-300 BDSF
Year of manufacture	1999
Serial number	29606
Total airframe time	84182 hrs
Engine type (number of)	CF6-80C2B6 (No. of engines - 2)
Maximum Allowable take-off weight	412,000lbs / 186,880kgs
Total aircraft cycles	14470
Certificate of airworthiness issued	22/06/2023
Certificate of Registration issued	22/06/2023
Date of last check	18/09/2023 (1 A Check)

1.6.2 Weight and balance

At the time of landing, it was estimated that the aircraft gross weight was 317,062lbs. and the position of the center of gravity (CG) for landing was estimated to have been 27.1% mean aerodynamic chord (MAC). Both were within the allowable Maximum Landing Weight (MLW) and the C of G range for the aircraft i.e.: the MLW of 326,000lbs. and CG envelope between 7% to 37% MAC.

1.6.3 Condition of the aircraft before departure

The aircraft was dispatched in accordance with the MEL with item 27-62-01-02 "Flight Controls, Auto Speed Brake System". With the MEL applied, and in relation to this event, notes for Operations (O) stated that crew were to extend the speed-brake manually for rejected landing or take-off. For landing, crew were to carry out the AUTO SPEEDBRAKE non normal checklist (QRH NNC 9.3), by NOT arming the speed-brake lever, and to manually extend the speed-brake after landing. According to the Flight Crew interview, they were aware of the MEL item and briefed accordingly prior to the flight and prior to top of descent.

A review of the tech log entries pertaining to the speed-brake on this aircraft for a period of 90 days prior to this accident was conducted by DHL Safety department and published in their internal investigation report. It revealed that starting from 7th July 2023 until the 18th September 2023 defect descriptions were entered in the Tech log regarding the speed-brake system on 11 occasions. These defects ranged from

- The auto speed-brake inoperative
- Auto speed-brake EICAS message after landing
- Auto speed-brake failure indication during approach for which manual selection was selected after landing
- Speed-brake not deploying after touchdown.

The resolutions ranged from system operational checks and CB reset.

On 13th September 2023, a tech log entry was made and indicated that at the request of Maintenance Operations Control (MOC), the auto speed brake actuator was removed due to repetitive defects. The actuator was replaced on the same day in accordance with the AMM 27-62- 04/201 and tests carried out were satisfactory.

On 15th September 2023, a tech log entry was made and indicated that the speed-brake did not deploy during touchdown. For this defect, the tech log resolution indicates a CB reset, and operational checks carried out satisfactorily.

On 16th September 2023, a tech log entry was made and indicated that the speed-brake did not deploy during touchdown. For this defect, the tech log resolution states operational checks carried out satisfactorily in accordance with AMM TASK 27-62-00-715-002.

A second entry in the tech log for the speed-brake not deploying was made later on 16th September 2023. Further operational checks were carried out in accordance with AMM 27-62-01-705-002 and AMM 27-62-00-825-022. Both were satisfactory.

A similar entry regarding failure to deploy was recorded on 17th September 2023. On this occasion, maintenance reported via tech log entry that "auto speed brake actuator arming switch S371 adjusted IAW AMM 27-62-00/401 system tests were carried out with air/gnd and autothrottle simulation. Functional tests in accordance with AMM 27-62-00/501 found the system serviceable".

On 18th September 2023, the tech log information indicated that on request from MOC, the auto speed-brake arming switch S371 was replaced in accordance with AMM 27-62-06/201. During test auto speed-brake lever auto deployment to up was intermittent.

On the same day, an entry was made in the tech log and it added that the auto speed-brake system was deferred IAW MEL 27-62-01-02 CAT C. Maintenance procedure carried out IAW Dispatch Deviation Guide (DDG) AMM 27-00-0:

1. "SPEEDBRAKE AUTOSTOW" and "AUTO SPEEDBRAKE" CBS pulled and collared
2. "AUTO SPEEDBRAKE" OVERHEAD ANNUNCIATOR bulbs removed 3. Electr connector removed from SAC and connected to test connector. It added ‘please observe operations procedure. ‘

Limitations include:

(M)(O) may be inoperative provided:

A) System is deactivated,
B) Speed-brake handle forces are verified normal from full down to full up position,
C) AFM decrements are applied if landing performance requires use of auto speed brakes, and
D) Airspeed does not exceed 290 kias, or .84 mach, whichever is lower, when inflight gross weight is in excess of 340,000 lbs (154,545 kg).

1.6.4 Maintenance operations follow-up

Once the aircraft was taxied into the stand and after opening the door, the ground staff asked the engineer to go down to see the damage. The panel for the ceiling was down in the cockpit over the Jump Seat and the Emergency Descent Device (EDD) had deployed. Once identifying the damage, the engineer went back into the cockpit and took the aircraft phone to call the Maintenance Ops Control (MOC) and inform them of a possible hard landing. He informed the MOC there is serious damage and confirmed the location of the damage and the station with picture. The Lebanese DGCA representative came on board about an hour after the landing.

DHL contacted Boeing who sent an AOG team to Beirut to inspect the aircraft and evaluate the damage. The aircraft stayed on ground at OLBA for a period of four months and was subjected to temporary repair. The Lebanese DGCA released the aircraft based on the authorization issued to DHL by the Bahrain Civil Aviation Authority (BCAA) to ferry fly the aircraft unpressurized to Shannon (SNN), Ireland, for permanent repair. This was completed and the aircraft was certified back to service.

1.6.5 Previous Hard Landings

The history of heavy landing on that particular aircraft for the period between January 2022 and August 2023 was checked through DHL records. It revealed an average of 1 landing per month above 1.8 G, two of which at OLBA. However, none was identified with quick nose wheel down input during derotation following main gear touchdown.

1.7 Meteorological Conditions

The Lebanese Civil Aviation Authority reviewed the data from the Lebanese Meteorological Services and the weather transmitted to the crew giving a wind of 240v340/4 Kt, a visibility of more than 10 Km, Few clouds at 2600 ft, a temperature of 28 degrees and a dew point of 22, a QNH 1009 and NOSIG. However, in their Air Safety Report submitted to DHL (Appendix 3), the crew reported the same weather, except for clouds, where they reported “Scattered” v/s “Few”. The engineer who sat in the cockpit reported that “the weather was clear, it was around sunset time and there was no wind or any clouds”.

1.8 Aids to Navigation

All navigation aids used during the event were serviceable.

1.9 Communications

Communication between the ATC and the flight were normal and had no impact on the accident.

1.10 Aerodrome Information

BRHIA, (OLBA), Beirut, Lebanon, is an international airport with a field elevation of 85’ MSL. The airport is managed and operated by the Directorate General of Civil Aviation (DGCA), who is also responsible for provision of Air Traffic Management & Services in Lebanon.

The airport has three runways:

- Runway 03-21 is 12, 467ft long, 3,800 meters.
- Runway 17-35 is 10,663ft long, 3,250 meters.
- Runway 16-34 is 11,138ft long, 3,395 meters.

Runways 03, 16, 17 are served by an Instrument Landing System (ILS). The airport is also served by a primary Raytheon Radar system, ASR-10SS and a Secondary radar system, MMSR Condor, MK-2 and with automatic Auto tract 2 Display. Due to potential GPS signal failure and/or spoofing, a NOTAM was issued by Lebanon advising crew not to plan any RNA/GNSS approaches until further advised.

1.11 Flight Recorders

The Boeing 767-300 type aircraft is equipped with a DFDR and a CVR.

1.11.1 DFDR

The DFDR is a L3 Harris FA2100, P/N 2100-4043-00, S/N 000550029.
It was recovered by the DGAC in Beirut following the accident and was taken to the BEA at Le Bourget in Paris by the IIC, another member of the investigation team (DGCA Flight Safety) and the Director of Safety and Ground Operations at DHL (Technical advisor to the Bahrain Accredited

Representative) on October 3, 2023. The BEA report is included as Appendix D to this report and incorporates plots of relevant parameters, in particular: Accelerations, aircraft pitch, main and nose gear tilt, control column position, air speed and calculated vertical speed.

Figure 10: Aircraft FDR

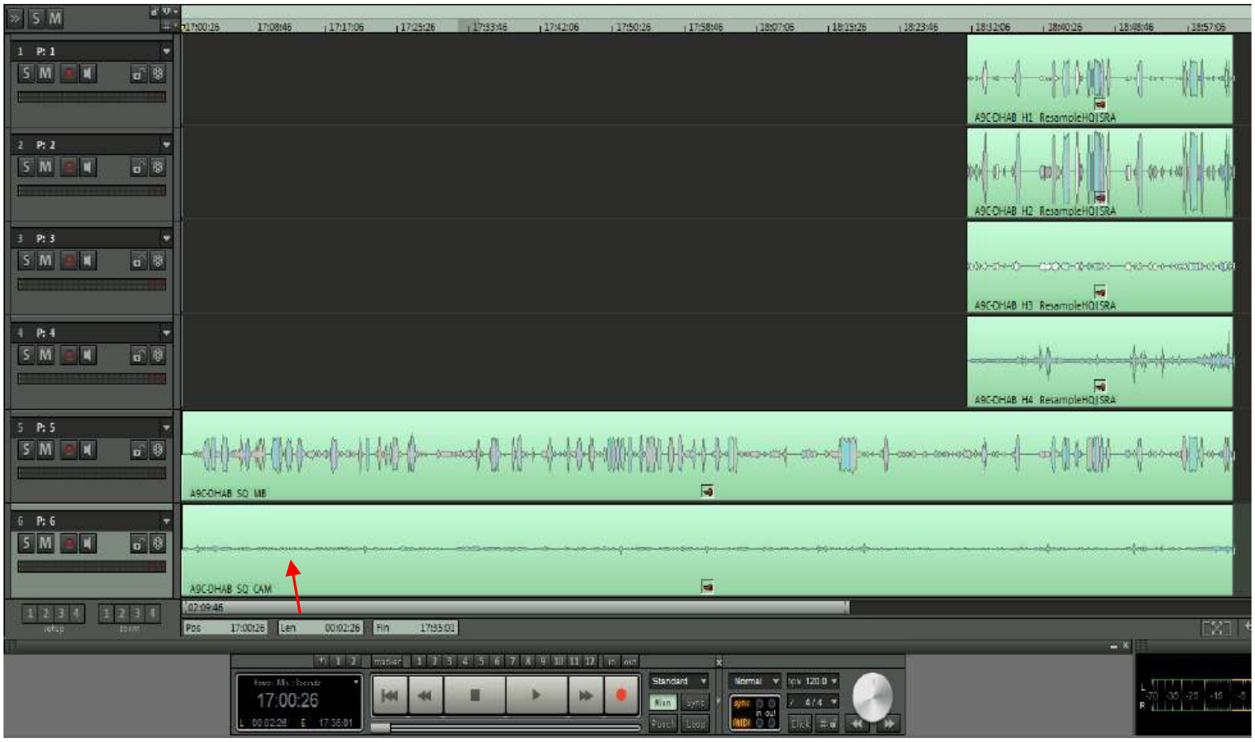
A question was sent to the Boeing representative in the investigation through the NTSB to check if there was a way to verify through the DFDR if the pressure on the nose gear for 19 seconds following the nose gear touch-down came from the pilot sitting in the right or left seat. The following answer was received: “as a follow up to your question with regards to identifying whether the control column was pushed via the left or right seat, the flight data recorder and airplane configuration on A9C-DHAB unfortunately does not provide control column force for either position, and only provides captain wheel/column position Boeing will typically use control column/wheel force as an indicator of who is on the controls. I don’t believe we would have success deriving anything further from the captains control wheel/column position given the linked control system, and would only be able to rely on the flight crew reports.”

1.11.2 The CVR

The CVR is a L3 FA2100-1020-99, P/N 2100-1020-99, S/N 00014693, which did not have the hardware Modification No. 7. It contained 4 audio files of 30 minutes in High Quality (HQ) and 2 audio files of 2 hours in Standard Quality (SQ).

The operator OMA issue 8, 31 August 2023, stipulates under Section 11.4.2 “If the crew or attending engineer(s) know or suspect that the incident may be classified as ‘serious’ they should ensure that the CVR and FDR are disabled as soon as possible to prevent data being overwritten”. This was not done immediately following the identification of the damage by the Flight Crew nor by the Engineer resulting in losing the record of communication between the crew before, during and right after the accident time.

The accident occurred at 16:09 UTC, the recording starts at 17:00:26 UTC and ends at 19:02:34 UTC (Refer to figure 11 below).



Start of the recording of the CVR (UTC)

Figure 11: CVR Recording Time Scope

1.11.3 WQAR

The aircraft was also equipped with a Wireless Quick Access Recorder (WQAR). The data from the WQAR was downloaded by DHL to assist with the data analysis.

That data was published in a DHL internal investigation report and is appended to this report as Appendix D.

1.12 Wreckage and Impact Information

According to interviews with the Flight Crew and the engineer on board, following the hard landing and during the aircraft deceleration phase, the Captain (PM) took over control as PF and taxied the aircraft to its parking stand. Once parked, he checked with the engineer the damage to the aircraft, which are described in section 1.3 above.

1.13 Medical and Pathological Information

No specific medical condition that could have contributed to that accident was identified. It should be noted that no drug and/or alcohol test were administered to the crew following the accident.

1.14 Fire

Based on the elements recovered, no evidence of fire has been brought up.

1.15 Survival Aspects

N/A

1.16 Tests and Research

1.16.1 Calculation of the load on the nose wheel

The IIC requested from Boeing, through the NTSB accredited representative, to calculate the maximum load on the nose wheel from the DFDR Raw data. The following summarizes the Boeing up-date based on the data provided:

1. The peak nose gear loading event likely occurred on the second touchdown of the nose gear. This is based on the pitch and normal acceleration data, pitch angle, pitch rate, air ground, spoilers, and the column input time history data.

2. The nose gear side load was not significant

3. The nose gear experienced a significant vertical load, potentially up to 160% of limit load. Again, note that the nose gear loading analysis contains uncertainty based on flight test data not fully representative of the IAI modification, and is an upper limit rather than nominal value.
    a. This is based on an assessment of the parameters listed in (1) (Appendix E)
    b. Conservative estimate of nose gear vertical loading based on the available data is potentially up to 160% of limit load because Boeing suspects it was balancing the load to reverse the pitch inertia as well as the aerodynamic pitching moment caused by the negative column deflection.
    c. With the addition of any side load, this may put the nose gear load over ultimate design level (150% of limit), however as DHL BH inspections confirmed there was no reported damage to the nose gear and therefore it is unlikely the upper limit was reached.

4. It is probable that the fuselage loads exceeded the ultimate load level during this event. Based on the analysis of the fuselage shear and bending moment, Boeing anticipates the bending moment exceeded the 767-300ER passenger design loads during the event.

Analysis of the fuselage bending moment at station 654+88 shows a significant exceedance relative to ultimate design loads. Worst case inertia and payload for fuselage bending moment were conservatively assumed. There is uncertainty in this analysis because Boeing did not certify this passenger-to-freighter modification. Consequently, Boeing's assessment is approximate not knowing the exact configuration or design loads for comparison. Alternatively, Boeing's assessment of the 767-300F (freighter baseline TC design) would not have encountered a structural failure based on the structural reinforcement present in the fuselage.

Feedback from IAI was obtained through the DHL representative to the investigation and revealed that "The landing weight is within the OEM (PAX) weight limits and the nose landing gear and back-up structure is not affected by the IAI BDSF conversion".

As a wrap-up to the communication between the IIC, the NTSB, Boeing, DHL and the IAI (through DHL), the Boeing representative concluded that "Boeing has provided the investigation it's conservative estimate of nose gear loading based on the event aircraft recorded data and modeling from flight test data on the baseline 767-300, however it remains conservative because Boeing does not own the design of the IAI modification. If IAI cannot perform its own analysis as the STC holder, Boeing recommends the Lebanon DGCA use the conservative analysis provided along with the inspection results to characterize the event".

1.16.2 Review of Boeing 767 previous de-rotation events with structural damage

De-rotation is the lowering of the aircraft's nose gear to the runway following touchdown on the main gear during landing. The Boeing 767-300 entered service with Japan Airlines on 20th October 1986. In a review of previous investigation reports, the investigation was able to identify ten similar de-rotation accidents involving Boeing 757/767 aircraft. Those accidents were investigated as appropriate in due time and the investigation reports published. The following is a list of these accidents:

- 16th January 1992 - Asiana Airlines in Cheu Island, South Korea
- 17th October 1992 – American Airlines flight 957 in São Paulo, Brazil
- 31st December 1993 – LOT flight 002 in Warsaw, Poland
- 31st July 1997 – Federal Express in Newark, New Jersey
- 22nd May 2002 – Monarch Airlines in Gibraltar
- 20th April 2009 – Royal Air Maroc flight 200 in New York, New York
- 3rd October 2010 – Thomson Airways BY519 in Bristol, UK
- 20th June 2012 – All Nippon Airways in Narita, Japan
- 18th August 2019 – Delta Air Lines 414 in Ponta Delgada, Portugal
- 23rd August 2023 – United Airlines in Houston, Texas

Despite varying contexts that contributed in many cases to these accidents, in particular cross-wind and/or turbulence (this was not the case with last one in August 2023), all 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. It should be noted that the DHL accident in BRHIA was not affected by turbulence or cross-wind.

Following the first three accidents mentioned above (1992-1993), Boeing conducted a review, which concluded that the 3 accidents had been due to:

- Excessive nose down elevator commanded
- Bounce after initial main gear touchdown, and
- Operating in moderate to high crosswinds

Responding to these accidents, Boeing took the following countermeasures:

- Strengthening of the structure of the forward fuselage upper crown
- Change of metering pin to reduce the maximum impact on nose landing gear
- Creation of training materials (video) for pilots of Boeing 767 and distribution of information magazines to notify relevant parties of a possibility that strong nose landing gear touch-down could cause damage on the fuselage

The upper crown stringers on the forward fuselage of the 767-300 were strengthened in the area where buckling often occurred following over-derotation. The modified design was incorporated into production airplanes in January 1995 including the accident plane, which was manufactured in 1999.

The 767-300 nose gear metering pin was optimized to absorb the energy produced during over-derotation events, thereby lowering the load on the nose gear. The metering pin device controls the flow of hydraulic fluid within the nose gear oleo strut. The modified design was incorporated into production airplanes in August 1994 and is available for retrofit on earlier 767-300s. Being manufactured in 1999, the accident airplane had this modification installed.

The training material developed consisted of video produced by Boeing to increase flight crew awareness of the potential for both nose gear and airframe damage as a consequence of over-derotation. The nine-minute video serves as a refresher for flight crews and was sent to all Boeing airline customers. This video remains available to B767 operators via “MyBoeingFleet” secure on-line platform portal, despite the fact that the production of the B767-300 passenger variant, similar to the one involved in the accident, which was converted later to Cargo at IAI, ended in 2014. Nevertheless, Boeing continued producing the B767-300F and 767-2C variants beyond that date.

DHL Bahrain, who acquired its first B767-300 type aircraft after 2014, did not have that video and the accident flight crew had not viewed the video prior to the accident. However, following that accident, DHL was able to download the video from the following site: https://www.youtube.com/watch?v=EuxBP4t8B30 This video was subsequently shared with the DHL Flight Crew Training department for their review and dissemination to crew.

Boeing also issued Flight Operations Technical Bulletin number 767-47, dated February 1, 1993, addressing “767 Landing Techniques." The bulletin informed pilots that sufficient elevator authority is available to develop excessive pitch rates if full nose- down elevator is used during landing. It ended with the statement "Flight crews should be advised that full nose down elevator during landing is not necessary, and if used, may result in structural damage." An attachment to the bulletin listed the 7- step B-767 flare and landing procedure.

Furthermore, Boeing published in its April 2002 edition of the Aero magazine an article entitled "Preventing hard nose-gear touchdowns". The same article was reproduced with permission from Boeing in the Autumn 2002 edition of the Focus magazine, issued by the UK Safety Committee. The preface stated: "In recent years, there has been an increase in the incidence of significant structural damage to commercial airplanes from hard nose gear touchdowns. In most case, the main gear touchdowns were relatively normal. The damage resulted from high nose-down pitch rates generated by full or nearly full forward control column application before nose gear touchdown. Flight crews need to be aware of the potential for significant structural damage from hard nose gear contact and to know which actions to take to prevent such incidents. Hard nose gear landings can produce heavy loads on the nose gear and its support structure. The resulting high stresses in the forward fuselage upper crown and between the flight deck and wing front spar can cause the fuselage structure to buckle. Appropriate actions by the flight crew can help prevent such incidents". The article concluded that "Flight crews can reduce the chances of aircraft damage from hard nose gear contact by avoiding high derotation rate and excessive forward column input."

DHL and the flight crew of the accident flight were not aware of that article prior to the accident. However, DHL disseminated the article to its Flight Crew following the accident.

Further recommendations from other investigations were incorporated into the aircraft operations and training manuals and reflected in the DHL documents that will be discussed in section 1.18 of this report.

1.16.3 Study conducted by DHL Safety department

As part of its SMS action following the accident, the DHL Safety department included excessive elevator input parameter in the flight data program for detection and to evaluate whether this particular crew de-rotation action was an isolated event or had any similarity by other crew members during operations.

Following this safety monitoring action, a detailed analyses found that a number of crew were making nose down input after nosewheel touchdown, contrary to what is described in the FCTM. Crew members were contacted, and the safety risk was tabled at the Flight Safety Action Group.

Subsequently, a waiver of anonymity was obtained as per the SMSM protocol, and the identity of the top 10 crew involved was provided to the training department. The Training department reported they will reiterate to the crew the correct procedures for derotation as per the FCTM.

While training has incorporated aspects of awareness to nose down inputs during landing, those crew who use this technique were interviewed by the Safety Department, which found that they had used this technique on their previous aircraft type or been taught this from their previous company's trainer, who used this on 'their' previous aircraft type.

Flight Operations requested to inform trainers of this finding and while training of new joiners and recurrent training, to note if this technique is used, and to provide remedial training as appropriate. Effectiveness of this will be measured through associated event in Flight Data Monitoring.

1.17 Information on Organizations and Management

1.17.1 DHL Aviation ME

The following description of DHL Aviation was obtained from their Director Safety and Ground Operations, who acts as technical advisor to the Bahraini accredited representative.

DHL Aviation EEMEA B.S.C. (C), is a cargo airline based in in the Kingdom of Bahrain. It employs 298 staff to dispatch, fly and maintain a fleet of Boeing 767-300 freighters operating under a Bahraini AOC, based at Bahrain International Airport.

DHL Aviation is the central platform for DHL Air Network Operations in the Middle East. It is wholly owned by Deutsche Post and operates the group's DHL-branded parcel and express services mainly in the Middle East and North Africa, also with flights to Europe, India and Far East.

The airline began dedicated cargo flights between Bahrain and Riyadh in 1979 with a Fokker F27 Friendship. In subsequent years, larger jet aircraft were introduced starting with B727’s in 2004, then progressing to B757-200 in 2010, B767-200, then B767-300 freighter, with each introduction the preceding aircraft were retired from the fleet.

The airline currently has a total of ten B767-300 freighters registered on the AOC, having been introduced from March 2021. These are a combination of Boeing (BCF) and IAI (BDSF) conversions.

The VP Airline ME is the Accountable Manager, responsible for the management and operation of the AOC. The senior management reporting to the Accountable manager consists of Postholders for Flight Operations, Technical, Flight Crew Training, Security, Quality and Safety and Ground Operations.

The Post Holders for Quality and Safety have an open line of communication with senior management, to ensure quality and safety topics are afforded the proper level of attention and solutions are implemented in a timely manner.

This is facilitated by several means including reviews of reported events at Monthly Safety Action Groups, be they from the crew reporting or as flagged by the Flight Data monitoring program.

The airline is registered under the IATA Operational Safety Audit (IOSA) program, including confirmation of the implementation of the Safety Management System.

1.17.2 Review of oversight by the Bahrain CAA

The Bahrain CAA conducts regular oversight activities on the airline and its management system.

1.18 Additional information

1.18.1 Normal and Supplementary Procedures

The Operations Manual Part B (B767-300), Issue 2, Amendment 3, 31 August 2023 stipulates in sub-section 0.1.5.1 “Normal procedures are used by the trained flight crew to ensure the aircraft condition is acceptable for flight and that the cockpit is correctly configured for each phase of flight. These procedures assume that all systems are operating normally and that automated features are fully utilized. Normal procedures are performed from recall and follow a panel scan pattern. These procedures are designed to minimize crew workload and are consistent with new flight deck technology. All procedural information is task orientated”. That section stipulates “On the ground the speed-brake will only be operated by the LHS pilot”.

In sub-section 0.1.5.2 it describes supplementary procedure as “normal procedures that are accomplished as required, rather than routinely performed on each flight”.

1.18.2 Flare and Touchdown

The DHL Boeing 767 Flight Crew Training Manual (FCTM) revision 23, June 30, 2023, 6.8 stipulates “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. Begin with a stabilized approach on speed, in trim and on glide path.

Note: When a manual landing is planned from an approach with the autopilot engaged, the transition to manual flight should be planned early enough to allow the pilot time to establish airplane control before beginning the flare. The PF should consider disengaging the autopilot and disconnecting the auto-throttle 1 to 2 nm before the threshold, or approximately 300 to 600 feet above field elevation. 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 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. A touchdown attitude as depicted in the figure below is normal with an airspeed of approximately VREF. Ideally, main gear touchdown should occur simultaneously with thrust levers reaching idle.

Avoid rapid control column movements during the flare. If the flare is too abrupt and thrust is excessive near touchdown, the airplane tends to float in ground effect. Do not allow the airplane to float or attempt to hold it off. Fly the airplane onto the runway at the desired touchdown point and at the desired airspeed.

Note: Do not trim during the flare. Trimming in the flare increases the possibility of a tail strike.

Prolonged flare increases airplane pitch attitude 2° to 3°. When prolonged flare is coupled with a misjudged height above the runway, a tail strike is possible. Do not prolong the flare in an attempt to achieve a perfectly smooth touchdown. A smooth touchdown is not the criterion for a safe landing.

Typically, the pitch attitude increases slightly during the actual landing, but avoid over-rotating. Do not increase the pitch attitude, trim, or hold the nose wheel off the runway after landing. This could lead to a tail strike.

1.18.3 Landing Roll Technique

The DHL Boeing 767 FCTM 6.24 stipulates "avoid touching down with thrust above idle since this may establish an airplane nose up pitch tendency and increase landing roll. After main gear touchdown, initiate the landing roll procedure. Fly the nose wheels smoothly onto the runway without delay. If the speed-brakes do not extend automatically move the speed-brake 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. To avoid the risk of a tail strike, do not allow the pitch attitude to increase after touchdown. However, applying excessive nose down elevator during landing can result in substantial forward fuselage damage. Do not use full down elevator. Use an appropriate autobrake setting or manually apply wheel brakes smoothly with steadily increasing pedal pressure as required for runway condition and runway length available. Maintain deceleration rate with constant or increasing brake pressure as required until stopped or desired taxi speed is reached."

1.18.4 Speed-Brakes operation

The DHL Boeing 767 FCTM 6.24 describes the use of the speed brakes during landing "to spoil the lift from the wings, which places the airplane weight on the main landing gear, providing excellent brake effectiveness. If the speed brakes 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 speed brakes can be fully raised after touchdown while the nose wheels are lowered to the runway with no adverse pitch affects. Normally, speed brakes are armed to extend automatically. Both pilots should monitor automatic speed brake extension after touchdown. In the event auto extension fails, the speed brakes need to be manually extended. After touchdown, fly the nose wheels smoothly to the runway while slowly raising the speed brake to the up position. Pilot awareness of the position of the speed brake lever during the landing phase is important in the prevention of over-run. The position of the speed brakes should be announced during the landing phase by the PM. This improves the crew's situational awareness of the position of the speed brakes during landing and builds good habit patterns which can prevent failure to observe a malfunctioned or disarmed speed brake system".

The DHL OM-B (B767-300) 1.5.1, Issue 2, Amendment 3, 31 August 2023 stipulates: "In-flight the PF, whether in the LHS or RHS, may operate the speed brakes, but must keep his hand on the lever whilst they are in use. On the ground the speed brake will only be operated by the LHS pilot."

1.18.5 Directional Control and Braking during Landing Roll

The DHL Boeing 767 FCTM 6.25 stipulates "if the nose wheels are not promptly lowered to the runway, braking and steering capabilities are significantly degraded and no drag benefit is gained. Rudder control is effective to approximately 60 knots. Rudder pedal steering is sufficient for maintaining directional control during the rollout. Do not use the nose wheel steering tiller until reaching taxi speed. In a crosswind, displace the control wheel into the wind to maintain wings level which aids directional control. Perform the landing roll procedure immediately after touchdown. Any delay markedly increases the stopping distance. Use a combination of rudder, differential braking, and control wheel input to maintain runway centerline during strong crosswinds, gusty wind conditions or other situations. Maintain these control input(s) until reaching taxi speeds".

1.18.6 Preservation of DFDR and CVR

Regulations require that the CVR starts to record prior to the aircraft being able to move under its own power and that it continues to record until the end of the flight, when the engines have been shut down. Some aircraft are equipped with automatic interlocks, with the intent of preventing unnecessary operation of the CVR after the engines have been shut down; however, many aircraft, including the accident aircraft, operate the CVR whenever aircraft electrical power is "on". The CVR on the accident aircraft retains only the last 30 minutes of audio. It is therefore especially important that electrical power is quickly removed from a CVR if its information is to be preserved. This is normally done by pulling the respective circuit breaker(s).

The DHL OM-A issue 8, amendment 0, 31 August 2023, stipulates in sub-section 11.4.2 "The CVR and FDR are usually removed for the investigating authority after an accident or serious incident." It then stipulates the action by the crew or attending engineer(s) when they "know or suspect that the incident may be classified as 'serious' they should ensure that the CVR and FDR are disabled as soon as possible to prevent data being overwritten". However, it does not describe the procedure to do so (pull the associated CBs).

1.18.7 Inspection following Hard Landing

The Aircraft Maintenance Manual 05-51-01 requires aircraft that have experienced "Hard Landing" to be subjected to "a structural examination". A hard landing is normally classified as such when "the vertical acceleration exceeds 1.8G if recorded with at least 10 samples per second". However, the nose wheel vertical acceleration is not recorded and can occur and result in a hard nose wheel landing at DFDR vertical acceleration well below 1.8G recorded for the main landing gear.

1.19 New Investigation Techniques

No new technique was used.

2. Analysis

2.1 General

The flight crew members were properly certificated, qualified, experienced on type and properly rested prior to the flight from Bahrain to Beirut. The captain was PM and the F/O was the PF. No evidence was identified indicating any pre-existing history of medical or behavioral conditions that might have adversely affected the flight crew performance. They were also aware of the aircraft MEL item related to the speed brakes being inoperative and that they had to operate them manually after touch-down.

The DFDR data was retrieved at the BEA and provided accurate data of what has happened in accordance with the sources recorded as per the DFDR design. However, the CVR data coinciding with the time of the occurrence was overwritten as the aircraft was powered by electricity from the time it landed till the DGCA requested the flight recorders, thus depriving the investigation from valuable accurate source of audio information that could have explained some of the data retrieved from the DFDR and leaving no choice to the investigators other than relying on information received from the pilots and the engineer who were on board.

The airplane was certificated, equipped, and dispatched in accordance with the Bahrain CAA regulations and approved DHL Aviation procedures. It was a passenger B767-300 type aircraft that was converted to Cargo and certified accordingly. Apart from the MEL item related to the auto speed brake being inoperative, of which the flight crew were aware and briefed each other accordingly, the DFDR data did not show any evidence of a warning linked to a system malfunction, or a major failure occurring during the flight.

At the time of the accident, it was still day light, though close to sunset. The visibility was clear with light westerly winds prevailing and few clouds at 2600 feet. Therefore, weather was not a factor in that accident.

This type of accident to that particular type of aircraft had happened and mitigation actions consisting of design modification and training recommendations were previously developed and implemented, which resulted in a huge reduction of recurrence, considering the number of aircraft in service and the number of hours accumulated by the B767-300 through the years. However, the fact that the same type of accident recurred after 37 years of the introduction into service of that type of aircraft needs to be addressed to determine if, in addition to the immediate actions by the crew leading to the accident, any systemic issues related to policy, procedures and training need to be addressed to explain the crew actions.

2.2 Analysis of the flight

The flight is considered normal till the first main gear touchdown with vertical acceleration of +1.32 G, a pitch angle of 3.2 degrees and the left gear touching down 1 second before the right gear, as indicated by the DFDR reading.

With the main gear on ground the speed-brakes were manually deployed by the F/O who was PF, as confirmed by both pilots and in accordance with the briefing given prior to landing, which is in contradiction to the policy stipulated in the DHL OM-B (B767-300) 1.5.1, Issue 2, Amendment 3, 31 August 2023 that clearly states that “On the ground the speed brake will only be operated by the LHS pilot”.

The PF reported that he did previously manually operate the speed brakes on ground from the RHS and was comfortable with the procedure, and that upon his request the Captain agreed to allow him to manually operate the speed brakes during that particular landing after emphasizing that he should do that “slowly”. Nevertheless, this reflects routine deviation from procedure in that regard.

Following the main gear touchdown, the acceleration recorded + 1.352 G. The nose gear touchdown occurred after 1.5 seconds and resulted in a recorded + 1.771 G, which is within the normal operating envelop. However, immediately following that, and in conjunction with the manual speed brake operation, the DFDR records elevator input increase from +5.8 deg to + 11.1, then within one second to -18.3 deg associated with nosewheel air/ground movement from “ground” to “air” to “ground” within one second followed by a recorded acceleration of + 1.908 G (forces measured from the accelerometer in the main wheel well). This is a clear indication of an action inducing a positive input on the flight control that could have resulted from unintentional body movement resulting from operating the speed brake lever from the right-hand seat followed by a quick negative input on the control column by the flight crew as a reaction to the nose up movement in order to ensure the nose is firmly on ground and avoid a tail strike.

In fact, during the interview the F/O clearly stated that “as he leaned over to the left to reach the speed-brake lever, there was a slight left turn to the yolk” following which “the aircraft pitched up violently”. However, he denied reacting by pushing the yolk forward, but described the column as “acting aggressively” and further stated that the whole episode happened too fast and that he was unable to take control of the control column as “it moved away from him”. Taking that testimony at face value could indicate that the swift nose down input might have been introduced by the other crew member, in this case the captain, who was PM.

That assumption could not be verified by the DFDR records, as it registers the flight control yoke movement from the left-hand side only as both control columns are linked together. As such, it is not possible for the investigation to determine from the DFDR recording which control column was pushed forward. The testimony of the engineer sitting in the cockpit did not help much in that regard, as he stated he could not see the position of the hands of both pilots during that phase of the flight, which could also be attributed to the repercussions of the hard derotation and its sudden consequences.

The Captain testimony recalled that following the first derotation the aircraft “lurched up” and the nose wheel then slammed back down onto the runway, describing it as “horrendous” and that his headset and prescription glasses flew from his head and he reached his bag to get the second set of prescription glasses prior to take control of the aircraft. Under such circumstances he would not have been probably able to have his hands on the control column and in his bag at the same time. This suggests that the aircraft control following the second derotation remained with the F/O till the Captain called “I have control”, a scenario supported by the fact that the F/O stated during the interview that he maintained the aircraft on the center line after landing by using the rudder till the Captain called “I have control”, which occurred according to both pilots’ testimonies a few seconds after touchdown. When asked to be more precise during the interview, both pilots determined the time between the second nose touchdown and the captain ordering “I have control” as being between 10-12 seconds.

The fact that the sudden push resulted in a nose down input on the flight control leading to a recorded elevator position of -20.6 deg for a period of 19 seconds indicates that whoever was pushing the control column forward maintained the same pressure on the control column till after the Captain called “I have control” and that this input was a result of a startle reaction to avoid a tail strike following the nose up movement that followed the first derotation as a result of a recorded control column movement from +5.8 to +11.1. Under such a startle effect, the F/O was not able to recall whether he froze on the control column, the Captain was too busy reaching his eye glasses, thus he couldn’t have had his hands on the control column while searching his bag at the same time, and the engineer was under shock as a result of the hard derotation so he couldn’t determine the position of the hands of either pilot. The absence of CVR recording deprived the investigation of valuable information that might have solved without doubt that issue.

The fact remains that the swift push on the control column by the flight crew from +11.1 to -18.9 within 1 second then – 20.6 resulted in a hard nose wheel touch down during the second derotation leading to substantial fuselage damage predicted in the DHL Boeing 767 FCTM 6.24 as a consequence of such derotation, which in this case could have probably been the result of a startle effect by a flight crew member.

2.3 Systemic Training Issues

Following the accident and during the interview with the crew and DHL management, the history of hard derotation was discussed and the Boeing mitigation actions and recommendations were reviewed.

The technical design mitigation measures linked to the aircraft design were not a factor in that accident, since the accident aircraft was produced at a date following that of the design improvement implementation that resulted from mitigation actions addressing findings on earlier similar accident investigations.

The DHL documentation related to flight crew training incorporated the Boeing recommendations as stipulated in the DHL FCTM, in particular sub-section 6.24. This is in line with the manufacturer FCTM and is supplemented by the awareness video that was available on the Boeing’s “My Boeing Fleet” portal. However, DHL, acquired their aircraft from the second-hand market, indicated they were not aware of the video or its location prior to the accident, but was able to download that video from YouTube and incorporated it into their pilot awareness training on the topic as part of their corrective action following the accident.

2.4 Operator's Action Following the Accident

Following the accident, DHL carried, as part of its internal investigation, a study based on recorded data retrieved from its FDM program to identify excessive elevator nose down input after nose wheel touchdown after derotation. That study revealed that, in contrast to what is mentioned in their FCTM, some crew members were applying nose wheel pressure input following derotation. In line with their SMSM protocol, the name of the top 10 crew involved was provided to the training department.

While training had incorporated aspects of awareness to nose down inputs during landing, those crew who use this technique of applying elevator nose down input following derotation were interviewed by the Safety Department, which found that they had used this technique on their previous aircraft type or been taught this from their previous company's trainer, who used this on 'their' previous aircraft type. Flight Operations requested to inform trainers of this finding while training of new joiners and during recurrent training, to verify if this technique is used, and to provide remedial training as appropriate.

In addition to addressing that operational issue, DHL sent its aircraft to a MRO in Ireland where it was subjected to a full approved repair and was integrated again into actual service with the airline.

2.5 Manufacturer's Action Following the Accident

Following the accident, Boeing published a newsletter to all operators to clarify the types of guidance that they supply to Flight Crew. The introductory Wingtips newsletter published on 28 August 2025 (issue No. 0), although it did not address directly issues related to the B767-300 type aircraft, it offered the following guidance related to Boeing communication to Flight Crew:

Boeing realizes timely and accurate dissemination of Flight Crew guidance is important. These communications come in the following formats:

- Flight Crew Operations Manual (FCOM) and associated Quick Reference Handbook (QRH).
- FCOM Bulletin (sometimes referred to as an FCOM Operations Manual Bulletin (OMB))
- Flight Crew Training Manual (FCTM)
- Flight Operations Technical Bulletin (FOTB)
- Multi Operator Message (MOM)
- Fleet Team Digest (FTD)
- Wingtips Newsletter

Boeing reported that information in this and other Wingtips articles will be disseminated to all operators.

2.6 Examination of the Aircraft

The manufacturer was involved in evaluating the damages to the aircraft as a result of the accident, information from that evaluation is reflected in section 1.3 of this report. They were also involved through the NTSB to analyze the data retrieved from the DFDR reading and to answer some questions raised by the IIC.

In their analysis, Boeing confirmed that, based on the pitch and normal acceleration data, pitch angle, pitch rate, air ground, spoilers, and the column input time history data, the peak nose gear loading event likely occurred on the second touchdown of the nose gear.

They also stated that, based on yaw acceleration, rudder deflection, and worst-case assumption for yaw inertia based on airplane gross weight, the nose gear side load was not significant as it was only ~10% of the enveloping design load for nose gear side load.

However, they reported that the nose gear experienced a significant vertical load, potentially up to 160% of limit load, despite the fact that the nose gear loading analysis contains uncertainty based on flight test data not fully representative of the IAI modification, and is an upper limit rather than nominal value. They deduced that conservative estimate of nose gear vertical loading based on the available data is potentially up to160% of limit load because Boeing suspects it was balancing the load to reverse the pitch inertia as well as the aerodynamic pitching moment caused by the negative column deflection. With the addition of any significant side load, this may put the nose gear load over ultimate design level (150% of limit), however as DHL BH inspections confirmed, there was no reported damage to the nose gear and therefore it is unlikely the upper limit was reached. Boeing then concluded that it is probable that the fuselage loads exceeded the ultimate load level during this event. Based on the analysis of the fuselage shear and bending moment, the manufacturer anticipates the bending moment exceeded the 767-300ER passenger design loads during the event. Analysis of the fuselage bending moment at station 654+88 shows a significant exceedance relative to ultimate design loads. Worst case inertia and payload for fuselage bending moment were conservatively assumed.

However, Boeing added that there is uncertainty in this analysis because Boeing did not certify this passenger-to-freighter modification. Consequently, Boeing's assessment is approximate not knowing the exact configuration or design loads for comparison. Alternatively, Boeing's assessment of the 767-300F (freighter baseline TC design) would not have encountered a structural failure based on the structural reinforcement present in the fuselage.

By further evaluating the conversion map provided by IAI through DHL, it was determined that the damages to the fuselage as a result of the accident did not incorporate any part related to the conversion.

2.7 Preservation of Flight Recordings (CVR)

ICAO Annex 6, Part 1, standard 11.6 requires the operator to preserve all the flight recorders records of an aircraft involved in an accident or incident. Relevant regulations require that the CVR data starts to record prior to the aircraft being able to move under its own power and till the end of the flight. To ensure the regulations are satisfied, most aircrafts' CVR, including the accident aircraft, operate whenever the aircraft electrical power is "on". However, the CVR retains only 120 minutes of audio recording. As such, requirements to quickly remove electrical power from the CVR following an incident or accident is mandated by regulations and incorporated in the airlines' operations manuals. This is normally accomplished by pulling the CVR circuit breaker.

The DHL OMA complies with such regulations as its issue 8, 31 August 2023, stipulates under Section 11.4.2 "If the crew or attending engineer(s) know or suspect that the incident may be classified as 'serious' they should ensure that the CVR and FDR are disabled as soon as possible to prevent data being overwritten". This was not done immediately following the identification of the damage by the flight crew nor by the engineer, which resulted in losing the record of communication between the crew before, during and right after the accident time. The accident occurred at 16:09 UTC, the recording starts at 17:00:26 UTC and ends at 19:02:34 UTC, as documented in section 1.11.2 of this report.

The flight crew and the engineer were aware of the landing being heavier than normal. They were also made aware of the extent of damage to the fuselage as a result of the heavy derotation once they parked at the gate. They confirmed they did notify the company regarding the accident; the DHL Emergency Response Manual procedures requires the Flight Crew or the maintenance engineer to pull the DFDR and CVR CB in such circumstances. During the interview the Flight Crew confirmed they knew the requirement stipulated in the OM-A and ERM concerning the necessity to disable the CVR and they described the way this is done "by pulling the relevant circuit breaker".

Why this was not done? Probably a slip as a result of distraction caused by the flight crew and the engineer being under shock following the accident and after realizing its consequences, in addition to their focus on writing reports, evaluating the damages and contacting their maintenance base. By the time the Lebanese DGCA representative took knowledge indirectly of the occurrence, showed up on-board and asked to seize the aircraft recorders, the entire CVR record of the accident had been overwritten.

The circumstances of the CVR overrun are not confined to that accident. A review conducted by the AAIB in 2009 and referred to in a similar accident investigation in May 2012 revealed that out of 99 cases, "19 CVRs had been overwritten due to delays in removing electrical power". The AAIB investigation concluded that although the operator referred to the regulatory requirement for recorded data preservation, they did not provide instructions on how to ensure compliance. This was not the case in the DHL accident since the flight crew interview revealed they were familiar with the procedure to deactivate the flight recorders following an accident or serious incident; however, ways to ensure flight crew pay attention to such action under similar circumstances could be developed, in particular during training and through awareness campaigns, to make such requirement more effective. Furthermore, the implementation of a technical improvement to increase CVRs recording time to 25 hours, as recommended by NTSB A-18-30 and A-18-31 / October 2018, could also help in addressing such recurrent slips and in preserving valuable data.

3. Conclusions

3.1 Findings

3.1.1 The aircraft

1. The aircraft was certified, equipped and maintained in accordance with existing regulations and approved procedures.
2. The aircraft was airworthy when dispatched for the flight, with a MEL item 27-62-01-02 Flight Controls, Auto Speed Brake System.
3. The aircraft had been properly loaded with no indication of weight shift on landing.
4. The aircraft gross weight and the position of the center of gravity (CG) for landing were within the allowable Maximum Landing Weight (MLW) and the C of G range.
5. The aircraft behavior was the result of its response to the pilot's input on the control column throughout the landing roll.
6. The aircraft was structurally intact till the second nose wheel touch down.
7. The damage to the aircraft crown is consistent with damages occurring as a consequence of previous similar accidents to the same type of passengers' aircraft.
8. The operator indicated that they were not aware of additional guidance material in particular a video, which is considered to be supplemental enhancement to the primary information contained within the FCTM; the supplemental video and other reference material can be found on the manufacturer's information portal for operators (My Boeing Fleet).
9. The B767-300 IAI STC based on which the aircraft was converted from Passengers to Cargo does not require any strengthening in the area of the fuselage that was damaged.

3.1.2 The Flight Crew

1. The flight crew members were properly licensed, qualified and experienced on this type of aircraft and flight in accordance with existing Bahrain CAA regulations.
2. The Flight Crew Members were in compliance with the flight and duty time limitation regulations.
3. The flight crew possessed the proper medical certification and had the opportunity to have the appropriate rest to operate that flight.
4. The Flight Crew received all the documents related to weather and aircraft MEL status prior to the flight.
5. The Flight Crew were aware of the primary operational guidance as provided by Boeing and DHL in the FCTM.
6. The initial touchdown was normal, however the derotation was fast and hard, especially the second one.
7. Neither crew member recalls making the abrupt and continuous nose down input on the control column.
8. The damage to the crown of the upper fuselage occurred as a result of the Flight Crew action on the control column, in particular the second derotation.

9. The PF seated in the RHS operated the speed brakes manually after touchdown in contradiction to the DHL OM-B para 0.1.5.1 that stipulates “on the ground the speed brake will only be operated by the LHS pilot.
10. The CVR CB was not pulled out immediately by the Flight Crew or the Line Maintenance Engineer following the identification of the damage, as required by regulation and by the operator OM-A and ERM.

3.1.3 The Operator

1. The operator is IOSA certified with a safety program in place.
2. The operator SOP contained a policy and procedures for preserving Flight Recorders data following an accident or serious incident.
3. The operator SOP stipulated “on ground the speed brake will only be operated from the LHS”.
4. The SOP of the operator did contain material addressing proper landing technique and highlighting the negative consequences of applying nose wheel pressure input following derotation.
5. The training provided by the operator was not effective in preventing pilots from applying undesired nose down input after landing prior to the accident.
6. The operator safety system did not identify, prior to the accident, a trend of speed brake being manually operated from the RHS, contrary to its policy.
7. The operator FDM program did not identify a trend of pilots applying nose down input after landing prior to the accident.
8. The operator safety program immediately addressed the issue of pilots applying nose down input after landing following the accident and appropriate training and awareness campaign have been implemented swiftly.

3.2 Causes

3.2.1 Probable Cause

The swift second derotation of the aircraft during landing as a result of Flight Crew input on the flight control.

3.2.2 Contributing Factors

1- The operation of the speed brake from the RHS which could have induced unvoluntary body movement affecting the flight control upward resulting in a nose gear pitch up.
2- The landing sequence, with the nose gear pitching up following the main gear touch down, could have startled the Flight Crew who overreacted swiftly to prevent a tail strike by pushing the control column forward and maintained that pressure, contrary to the operator requirement.

4. Safety Recommendations

In accordance with Annex 13 to the Chicago Convention, the sole objective of the investigation shall be the prevention of accidents and incidents. Therefore, the following recommendations aim at preventing other accidents from similar causes.

4.1 The Operator

1- Should establish a procedure for maintenance base to remind Flight Crew and Maintenance Engineers to pull the recorders CB whenever the maintenance base is contacted following a suspected accident or serious incident (implemented)
2- Should review its pilots initial and recurrent training program to include available training and awareness resources and ensure appropriate derotation technique is enforced (implemented)
3- Should discuss derotation accidents during pilots training and review the lessons learned (implemented)
4- Should consider analyzing data related to pressure on the control column while derotation during landing (implemented)
5- Should share information on the accident and safety related recommendations within the company (implemented)

4.2 ICAO

1- Should consider adopting in its SARPs the NTSB recommendation A-18-31 published in October 2018 requiring “all newly manufactured airplanes that must have a cockpit voice recorder (CVR) be fitted with a CVR capable of recording the last 25 hours of audio”.
2- Should consider adopting in its SARPs the NTSB recommendation A-18-30 published in October 2018 requiring “retrofit of all cockpit voice recorders (CVR) on all airplanes required to carry both a CVR and a flight data recorder with a CVR capable of recording the last 25 hours of audio.”.

List of Appendices

Appendix A: Ministerial Decree Establishing the Committee

الجمهورية اللبنانية
وزارة الأشغال العامة والنقل

الوزيـــر

المديرية العامة للطيران المدني
الرقم: ٣٥٧٢/ص
التاريخ: ٢١ أيار ٢٠٢٣

قرار رقم ٤٠٨/١

تشكيل لجنة للتحقيق في واقعة الطائرة ذات التسجيل A9C-DHAB التابعة لشركة DHL في ١٨ أيلول ٢٠٢٣

إن وزير الأشغال العامة والنقل،
بناء على المرسوم رقم ٨٣٧٦ تاريخ ٢٠٢١/٠٩/١٠ (تشكيل الحكومة)،
بناء على المرسوم الإشتراعي رقم ١١٢ تاريخ ١٩٥٩/٦/١٢ وتعديلاته (تنظيم المديرية العامة للطيران المدني)،
بناء على المرسوم الإشتراعي ١٦١٠ تاريخ ١٩٧١/٧/٢٦ وتعديلاته (تنظيم المديرية العامة للطيران المدني)،
بناء على المرسوم رقم ١٤٨٣٨ تاريخ ١٩٦٣/١٢/١٨ (تأليف لجان التحقيق في حوادث الطيران)،
بناء على توصيات منظمة الطيران المدني الدولي لا سيما الملحق ١٣ لإتفاقية شيكاغو،
بناء على اقتراح المدير العام للطيران المدني بالتكليف،

٢١ أيار ٢٠٢٣

يقرر ما يلي:

المادة الأولى: تؤلف لجنة مهمتها التحقيق في واقعة الطائرة التابعة لشركة DHL من نوع BOEING 767 ذات التسجيل A9C-DHAB، الرقم التسلسلي MSN 29606 بتاريخ ١٨ أيلول ٢٠٢٣.

المادة الثانية: تتألف اللجنة المذكورة أعلاه من السادة الواردة أسماؤهم أدناه:

- الكابتن محمد عزيز، خبير في التحقيق بحوادث الطيران — رئيساً
- الدكتور عمر قدوحة، رئيس مصلحة سلامة الطيران — عضواً
- المهندس عياد بشارة، مفتش صلاحية طائرات في مصلحة سلامة الطيران — عضواً
- الكابتن شربل جرجس، محقق سلامة — عضواً
- ممثل عن الطيران المدني البحريني — عضواً

المادة الثالثة: بإمكان اللجنة المذكورة الطلب من شركة Boeing والمجلس الوطني لسلامة النقل الأميركي NTSB المشاركة بإجراء التحقيق في الواقعة وذلك بحسب الأنظمة والمعايير الدولية.

المادة الرابعة: ترفع اللجنة تقريرها إلى وزير الأشغال العامة والنقل من خلال المدير العام للطيران المدني وذلك بأسرع وقت ممكن.

المادة الخامسة: يطلب من جميع السلطات المعنية تسهيل عمل اللجنة المذكورة وتزويدها بجميع المستندات والتسجيلات المطلوبة والتي تراها ضرورية للتحقيق في أسباب الواقعة المذكورة.

المادة السادسة: يبلغ هذا القرار إلى من يلزم.

وزير الأشغال العامة والنقل
د. علي حمية

طبق الاصل
المشتركة
ياسمين نجم

٢١ أيار ٢٠٢٣

يبلغ الى:

- وزارة الأشغال العامة والنقل
- مجلس الخدمة المدنية
- التفتيش المركزي
- وزارة المالية – مديرية الصرفيات
- المديرية العامة للطيران المدني
- أصحاب العلاقة
- المحفوظات / الملف الشخصي

الدائرة / التبليغات / للاستعمال

مدير عام الطيران المدني بالتكليف
المهندس فادي الحسن

الفياضية، لبنان، هاتف: ٠٥/٤٥٩٦٨٠ – ٠٥/٤٥٩٦٧٠ – فاكس: ٠٥/٤٥٩٤٣٤

2 9 SEP 2023

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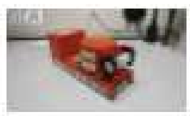
Appendix B: BEA report on the DFDR & CVR

Technical document

FDR and CVR readouts

Restricted release to the safety investigation members
Technical assistance for DGCA Lebanon

Document ID:	**BEA2023-0449_tec01**
Registration number:	**A9C-DHAB**
Aircraft type:	BOEING - 767 - 300 - 323
Date of occurrence:	18th September 2023
Place of occurrence:	Beirut (Lebanon)
Equipment examined:	

FDR L3 Harris FA2100 P/N: 2100-4043-00 S/N: 000550029	CVR L3 Harris FA2100 P/N: 2100-1020-99 S/N: 000142693
	

The Boeing B767-300 encountered a hard landing with substantial damages to the fuselage.

Work performed:

- **FDR**

The download has been performed on the October 3rd, 2023, with success.

Downloaded files:

The three following files have been downloaded:

- Name: A9C-DHAB.bin (Binary raw data)
  Size: 233363456 bytes (222 MiB)

- Name: A9C-DHAB.fdr (FA2100 compressed file)
  Size: 67109036 bytes (64 MiB)

-Name: A9C-DHAB.nbr (FA2100/FA2300 frame number data)
  Size: 1827648 bytes (1784 KiB)

The uncompressed data file is A9C-DHAB.bin (222 MiB) contains the recorded data. The file has been synchronized successfully with the BEA software (LEA). The data type is a .upk file with a Teledyne synchronization process at 256 words per second. There are 97 synchro areas with 126 h 34 min 51 (455,691 seconds) of synchronized data and the rate of synchro is 99.9787 %. The dataframe has been provided by the operator (767-3A from the Boeing document n° D226A101-4 Rev K of May 10, 2010).

- **CVR**

The CVR is a FA2100-1020 which did not have the hardware Modification No. 7. It contained 4 audio files of 30 minutes in High Quality (HQ) and 2 audio files of 2 hours in Standard Quality (SQ).

The raw file *A9C-DHAB.CVR* which contains the HQ files has been downloaded using the official mean of L3, *Portable Interface*. The raw file has been decompressed with the software *ROSE*. The following files have been obtained:

- A9C-DHAB_H1.wav (pilot or co-pilot channel)
- A9C-DHAB_H2.wav (pilot or co-pilot channel)
- A9C-DHAB_H3.wav (observer channel + Passenger Address)
- A9C-DHAB_H4.wav (Cockpit Area Microphone chanel)
- A9C-DHAB_SP.dat
- A9C-DHAB_SP.log

The 2 SQ audio files have been downloaded by converting the analogic signals at the output of the *Portable Interface* into numeric signals via the mixing console of the BEA *Red4Pre* and by recording the output signals with the software *Samplitude*. The first audio file *A9C-DHAB_SQ_MB.wav* is the mixed channel of the channels H1, H2 and H3 and the second audio file *A9C-DHAB_SQ_CAM.wav* is the Cockpit Area Microphone channel.

An overview of the audio project can be found in Appendix 3.

Note: The SHA256 fingerprints list of the files of the CVR are available in Appendix 1.

Results:

- **FDR**

The hard landing is recorded. Some relevant parameters are provided in Appendix 2 and also in excel format. Please note that the vertical speed is a calculated parameter derived from the altitude. These values must be considered with care especially close to the ground (ground effect).

- **CVR**

The event has not been recorded by the CVR. The hard landing occurred at 16:09Z while the recording of the CVR started at 17:00:26Z and stopped at 19:02:34Z[1].

[1] The information of the end of the recording of the CVR has been found in the file A9C-DHAB_SP.log which is used for the time synchronization of the CVR. The time of the start of the CVR has been deducted from it.

Appendix 1: CVR an FDR – SHA256 fingerprints list

Name: A9C-DHAB.CVR
Size: 36696064 bytes (34 MIB)
SHA256: 6AB9E684CF0F750FADECB5D8B49A38E733859FBC5E8B18216A4E17110333931F

Name: A9C-DHAB_H1.wav
Size: 29814956 bytes (28 MIB)
SHA256: 7E6D84BCB13D964CB2D5CA878D05D1C135B8EF023CCB4FD52F834DE301DDAECC

Name: A9C-DHAB_H2.wav
Size: 29814956 bytes (28 MIB)
SHA256: 2B4EFE70946377B4A99A1EEC37000E19FF27BA48A9138675F4901B22851402D7

Name: A9C-DHAB_H3.wav
Size: 29814956 bytes (28 MIB)
SHA256: CBE309FE72547AB17B3D2BD6987632C2D55FC32CBC213AAA1698612DFC3FF86A

Name: A9C-DHAB_H4.wav
Size: 59629868 bytes (56 MIB)
SHA256: 09898BD81E411CE7B8E23E15B98559D4A82B3444AC1DD06698D9F9F7F739C7AD

Name: A9C-DHAB_SP.dat
Size: 465912 bytes (454 KIB)
SHA256: F64958103706B84EDD98E154A5E24E430A10A28219F0F7757711A1348E1603DF

Name: A9C-DHAB_SP.log
Size: 291296 bytes (284 KIB)
SHA256: 2407604549705D38808F90D6486C8AB10FA8556917A8ED6D258F1F207121D621

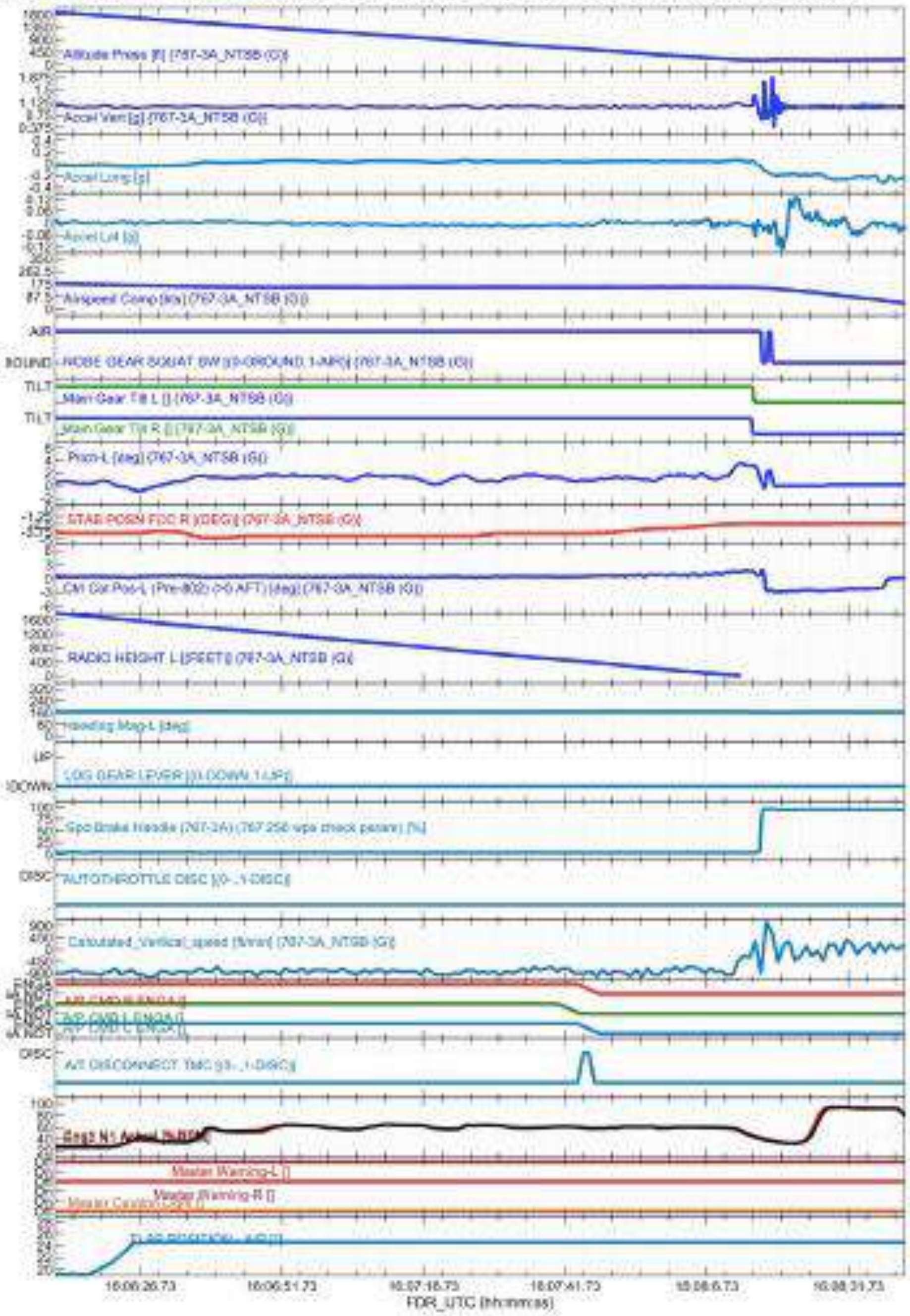
Name: A9C-DHAB.bin (Binary raw data)
Size: 233383456 bytes (222 MiB)
SHA256: 4CDAD4B74992039F5ACBDC996015C4820F847C4F46150048290200B7B0C538F8

Name: A9C-DHAB.fdr (FA2100 compressed file)
Size: 67109036 bytes (64 MiB)
SHA256:0C1412F6F15DF228CC8BBE0B57F0726BB76D43DB5B2905FDC11A1D0725175836

Name: A9C-DHAB.nbr (FA2100/FA2300 frame number data)
Size: 1827648 bytes (1784 KiB)
SHA256:40CAD0BE283510456DA74B6B5622C6B5D854A8C209F5FB96448800CA03E7EDD7

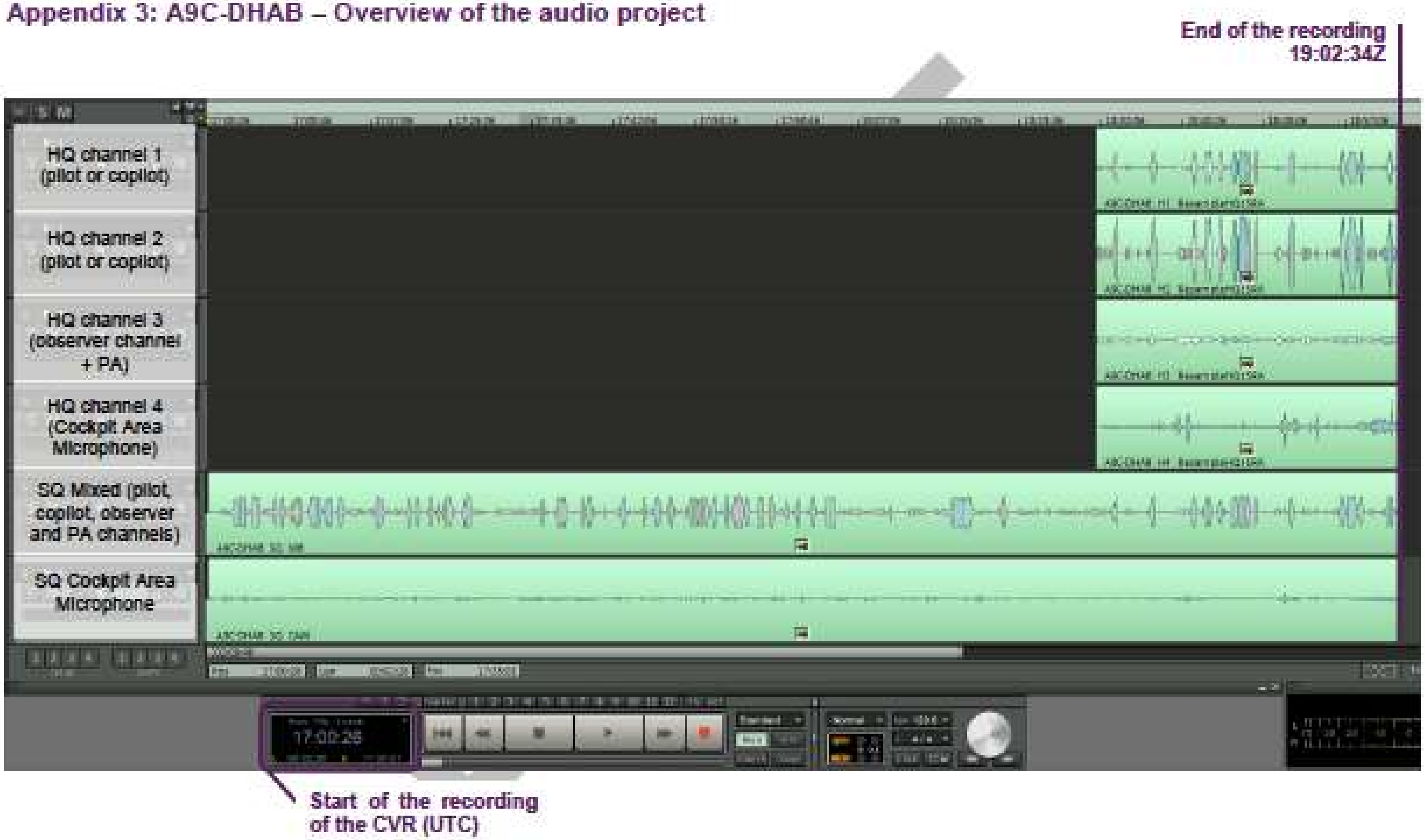
Appendix 2: Plots of relevant parameters

Note: Particular attention must be paid to the validation of the following parameters



BEA2023-0448_tec01 / A9C-DHAB – issued on 6 October 2023 4 / 5

Appendix 3: A9C-DHAB – Overview of the audio project



Appendix C: Flight Crew Air Safety Report (ASR)

DHL AVIATION

Report #1144

Kind of Report :	DHX Air Safety Report
Area of Occurrence :	Flight Safety
Type of Occurrence :	Flight Management
Event Classification :	Hard/Heavy Landing

General Information

Please define your name

Reporter :	confidential

In case of an anonymous report please enter 'Anonymous'

Please define a headline to your report

Title of Report :	Hard Landing
MOR Reportable? :	YES

General Flight Information:

Date & Time of Event (UTC) :	2023-09-18 16:09
Date & Time of Event (Local) :	2023-09-18 18:09
Flight Number :	160
Aircraft Registration :	A9C-DHAB
Aircraft type :	767-300
Manufacturer :	BOEING
Departure :	BAH
Date of Departure :	2023-09-18 12:20
Destination :	BEY
Date of Arrival :	2023-09-18 16:09
Location of Occurrence :	Arrival airport
Flight Phase :	Landing
Location on aerodrome :	On runway (1st Part)
Diversion :	
Call Sign :	DHX

DHX Air Safety Report
Report #1144
Report Status: Validation

-=CONFIDENTIAL=-

Print Date: 2023-09-20
Page 1

Report #1144

Inflight Return :	NO
Total number of persons on board :	3
Crew	
Pilot flying :	First Officer
Captain Name :	confidential
First Officer Name :	confidential
Other Crew :	confidential
Did you declare the occurrence?	
Emergency declared :	NO
ATC advised :	NO
Dispatch advised :	YES

Operational Information

Please fill, if speed and altitude were relevant regarding the event.

Altitude :	
Flight Level :	
Speed (kts) :	
Type of airspeed :	
Aircraft Configuration	
Autopilot :	Not Engaged
Gear :	DOWN
Flaps :	25
Spoilers :	OUT
Speedbrake :	N/A
Please fill, if flight rules and traffic type were relevant regarding the event.	
Current Flight Rules :	IFR
Current Traffic Type :	OAT (Operational Air Traffic)

Please fill, if Approach Type was relevant regarding the event.	
Instrument Approach Type :	ILS-complete
Please fill, if ATM was relevant to the event	
ATM contribution :	Unknown
Effect on ATM service :	Not determined
ATS Unit Name :	
FIR/UIR name :	|- OLBB : Beirut (FIR)
Airspace Type :	Unknown
Please define additional relevant information	
Training Flight :	NO
Type of Flight :	Cargo
RVSM :	
ETOPS Area :	
Techlog Entry made? :	YES
Techlog Reference :	A9C-DHAB000243-001
Coordinates of the event	
Latitude :	N 33° 50' 31.0000"
Longitude :	E 35° 28' 23.0000"

Weather Information

Was the event weather relevant?

Weather Relevant :	Unknown

If yes, please fill all relevant fields below.

Conditions and visibility

Visibility (m) :	9999
Weather Conditions :	Unknown
Restriction to visibility :	None
Light Conditions :	Dusk/twilight
Cloud Amount :	Scattered (3/8-4/8)
Air temperature (°C) :	28
Height of cloud base (ft) :	2600
Dew Point :	22

Wind

Wind Speed (kts) :	4
Wind Direction :	270
Speed measured at :	Surface
Relative Wind Direction :	Quartering tailwind
Wind Gusts :	Unknown
Turbulence Intensity :	Unknown
Maximum Gust (kts) :	

Precipitation and other weather phenomena

Weather phenomena :	
Phenomena intensity :	None

Weather Report

Weather Report :	SA 18/09/2023 16:00- > METAR OLBA 181600Z 27004KT 240V340 9999 FEW026 28/22 Q1009 NOSIG

Report #1144

Damage

Damage Information (if applicable)

Damage on aircraft :	Substantial
Third party damage :	NO
Object damaged :	None
Damage caused by 3rd party :	No

Fatigue

Fatigue Information

Was Fatigue a contributing factor? :	

Important: Please also write a fatigue report if you think your fatigue levels had an impact on the reported occurrence.

Report Text

Please provide all relevant information to the event

Report Text :	During landing on Rwy 16 in Beirut, the speedbrakes was extended manually and there was a hard landing. The auto speedbrake was inoperative. During the walkaround, the airplane fuselage was observed cracked.

As a general instruction, please inform our Safety department what happened, give details why it happened and in case you have any safety recommendations, please provide

MOR Reference Number

MOR Reference Number :	ALD-MOR-1291

Appendix D: DHL WQAR Data Review

The following was obtained from the DHL Final Investigation Report dated 10th March 2025:

Flight Data QAR Review

Control Column Movement

Based on pre-flight control check, the following are the control column max inputs Max Nose Up – +11 deg
Max Nose Down - -7deg

The recorded parameter is both Cpt and FO control column movement. The columns are physically joined and there are no individual sensors for movement and force for the FO column.

Approach

The flight data indicates passing 409 ft the autopilot was disengaged and was then followed by auto- throttle disengaged. Thereafter the approach remained stable with minimal flight crew inputs. At 20ft aal, the rate of descent was -650 ft/minute with a Vref +4.5 kts.

Main gear touch down

The aircraft is being 'flared' for the touch-down. The left main landing gear touched down (vertical acceleration: +1.32 G) with the pitch angle of about +3.2°, roll angle of about -1.1°, and airspeed of 150 kt. The right main gear touched down one second later.

When main gear touches down, the Rad Alt continued decreasing from -2ft to -6ft RA throughout this period with no period of increase, the control column correspondingly moving to a neutral position, from +4 deg to +1 deg over a 1.5 second period. Then within 1 second, the control column increases +5.9 deg, indicating being pulled back just before the nose gear touches down.

Nose gear first touch-down

As the nose gear squat switch “Gear (N) On Ground" records “Ground”, the control column is push forward past -6.94 deg. The nose gear oleo compresses and touch down is recorded with a vertical acceleration of +1.771G, which is measured from the accelerometers located in the main gear wheel well area.

The pitch attitude was initially 0.5 degrees at nose gear touch down, decreasing to -0.5 degrees minimum, then increasing through +1.6 degrees. The roll angle from 0° to the right 0.4°. At this time speed-brake handle parameters (C), (L), (R), (MCP) indicate that the handle was moved from approximately 4 degrees to 96 degrees, indicating the speed-brake was fully deployed manually, moving at a similar speed to an auto deployment. It remains at this value for the landing roll until when stowed.

The “Gear (N) On Ground" recorded “Ground” and about 1 second after that, it is recorded “Air”, as the nose gear bounces. The pitch increases to +2.5 degrees momentarily before decreasing with a recorded nose down push on the control column recorded as increasing to -7.29 deg.

<u>Nose gear second touch-down</u>

Thereafter the “Gear (N) On Ground" squat switch records “Ground”, with +1.91 G vertical acceleration at touchdown. The control column pitch input recorded as –7.29 deg and this lasted for more than 15 seconds before decreasing slightly.

<u>Thrust Reverser deployment</u>

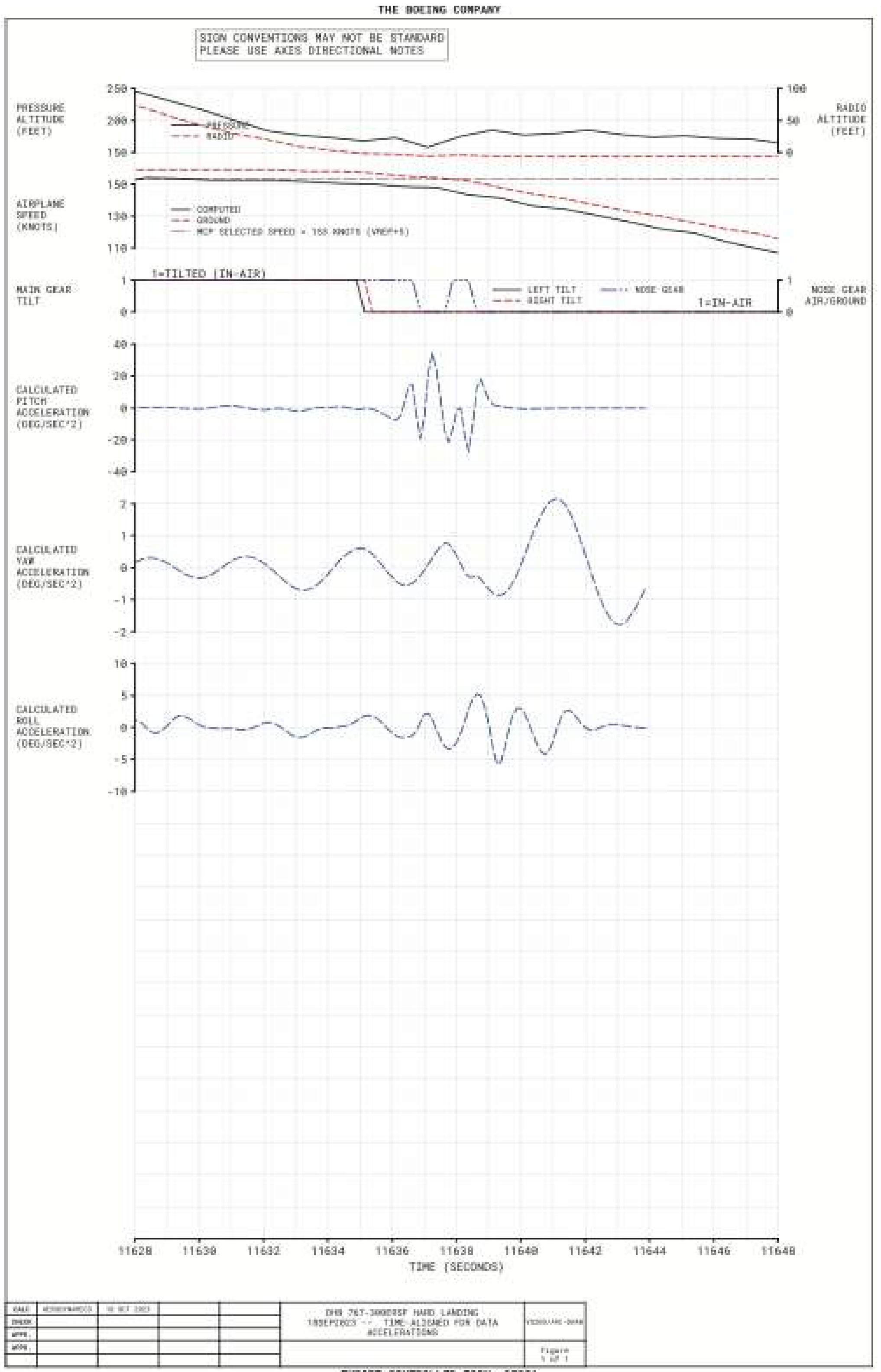
Soon after the Eng (1) Thrust Reverser “In Transit” followed by Eng (1) Thrust Reverser “Deployed” and Eng (2) Thrust Reverser “In Transit”. This was followed by Eng (1) and Eng (2) Thrust Reversers”.

<u>Landing roll</u>

Roll out was completed with a full nose down input on the control column, reducing from -7 to -6 deg. Just before the aircraft vacates the runway, the control column returns to a neutral position.

The aircraft continues and taxis to stand.

Appendix E: Time Aligned for Data Acceleration



Appendix F: DHL Internal Investigation Report

DHL AVIATION

Investigation Report
IQSMS Investigation ID: 11

Investigation Report

Investigation was performed based on the following template:
DHX Safety Investigation - DHX Safety Investigation form

Investigation Publication Date:	2025-03-10 05:58:24
Investigation published by:	Staines, Gavin
IQSMS Report ID	1144
Incident Description	On 18th September 2023, at approximately 16:09 UTC, a DHL Airlines B767-300 BDSF operating as DHX 160 sustained substantial damage following a hard landing on runway 16 at Beirut's Rafik Hariri International Airport (OLBA). The damage was discovered after arriving on stand, during walkaround inspection. There were no injuries to the two pilots, and the engineer on board. The airplane was operating a scheduled international flight, having departed from Bahrain International Airport (OBBI). Night time instrument meteorological conditions prevailed at the time of the landing, and the flight operated on an instrument flight rules flight plan. The crew reported that during landing on runway 16 in Beirut, the speedbrakes was extended manually and there was a hard landing. The auto speed brake had been made inoperative in accordance with approved maintenance procedures. During the walkaround by the flight crew, damage to the crown of the upper fuselage was observed. Following inspection, the crew contacted DHL Aviation Flight Control. The Lebanon Directorate General Civil Aviation (DGCA) and the Bahrain Civil Aviation Affairs (BCAA) were informed of the incident by DHL Aviation. The crew were debriefed by the Lebanon DGCA. The Digital Flight Data Recorder (DFDR) and Cockpit Voice Recorder (CVR), as well as copies of requested documentation were handed over to the Lebanon DGCA. The crew returned to Bahrain and met with DHL Aviation Flight Operations and Aviation Safety for further debrief. The aircraft was declared unserviceable (AOG) due to the damage. The accident is subject to an ICAO Annex 13 Safety Investigation led by the Lebanese DGCA, with BCAA and DHL Aviation Safety assisting. This report is produced for documentation internal safety actions and recommendations, pending publication of the formal report by the DGCA.
Status	Investigation open

Staines, Gavin
Lead Investigator

Summary of Safety Recommendations:
(Details to each recommendation find in the relevant section of this report)

Recommendation 1:

Title	Cockpit Voice Recorder (CVR): Retention of critical data
Risk Rating:	Safety relevant
Responsible(s):	Technical Director

Recommendation is accepted by Responsible Person(s): ☐ Yes ☐ No

Signature:

Print Date: 2025-03-10
Printed by: Staines, Gavin
Page 1

Recommendation 2:

Title	Cockpit Voice Recorder (CVR): Procedures for protection of recordings
Risk Rating:	Safety relevant
Responsible(s):	Director Flight Operations, Director Safety and Ground Ops, Technical Director

Recommendation is accepted by Responsible Person(s): ☐ Yes ☐ No

Signature:

Recommendation 3:

Title	Flight crew training
Risk Rating:	Safety relevant
Responsible(s):	Director Safety and Ground Ops, Senior Manager Flight Crew Training

Recommendation is accepted by Responsible Person(s): ☐ Yes ☐ No

Signature:

Recommendation 4:

Title	Manual speedbrake deployment
Risk Rating:	Safety relevant
Responsible(s):	Chief Pilot

Recommendation is accepted by Responsible Person(s): ☐ Yes ☐ No

Signature:

Recommendation 5:

Title	Review of external draft final report
Risk Rating:	Safety relevant
Responsible(s):	Director Safety and Ground Ops

Recommendation is accepted by Responsible Person(s): ☐ Yes ☐ No

Signature:

1. Factual information	
Factual Information	1.1 History of flight The following has been constructed based on the crew narrative, interviews, and flight data records. The flight crew comprised of the Captain who was the Pilot Monitoring (PM) on this sector and handling the aircraft radios, while the First Officer was the Pilot Flying (PF). The two crew members met at the Bahrain Flight Dispatch office to review the flight. In addition, an engineer was onboard as part of the crew to attend to maintenance duties on ground for the transit flight. There is no engineering team at Beirut (BEY) and the engineer would normally depart for the return flight. The engineer was sat in the observer seat, positioned directly behind and in between the pilots. He did not have a headset on. The crew reported that the aircraft was dispatched under MEL item 27-62-01-02 Flight Controls, Auto Speed Brake System. The crew discussed implication of the MEL, and while the Captain had previously informed the PF that he would deploy the speedbrake, he agreed with the PF's request to operate the speedbrake handle after landing. The PF added that he had done this previously and was comfortable with procedure for manual deployment. The use and manner of deployment of the speedbrake was discussed further before take-off and at the top of descent briefing, where the Captain emphasized again to the PF to "deploy the speedbrake slowly". On descent Beirut ATC provided shortcuts. The aircraft then established on the ILS runway 16 with the autothrottle and autopilot engaged. The flight data records indicate that the aircraft was fully configured and stable and on profile at 1,423ft RA with a planned flaps 25 landing. Passing 500ft RA, the PM made the stable call. Data indicates autopilot was disengaged at 16:07:44 UTC, followed by the autothrust disengaged at 16:07:45 UTC, at 409ft aal. The landing was continued with flight data records indicating first left then one second later the right main landing gear touchdown at 16:08:15 UTC, with what the Captain recalled at the debrief as a perfect touchdown. Shortly after touchdown of the main gear, the PF released his left hand from the thrust levers to operate the Speed Brake. He recalled that as he leaned over to the left, there was a slight left turn to the control wheel. At this point, the PM recalled that the aircraft "lurched up" and the nosewheel then slammed back down onto the runway, describing it as "horrendous" and that his headset and prescription glasses flew from his head. On his part, the PF recalled that the aircraft pitched up quickly, then came down violently, describing the column as "acting aggressively". He added that it flew from his hands and was unable to grasp it. The PF stated that the whole episode happened too fast and that he was unable to take control of the control column as it moved away from him. The flight data indicates that a 20ft aal, the rate of descent was - 650 ft/minute with a Vref +4.5 kts. Following the main gear touchdown, a gravitational force equivalent (G) of about + 1.3 G. was recorded, which is comparative to the fleet average for touchdown. The nose gear touchdown occurred after 1.5 seconds and resulted in a recorded + 1.8 G. The data further indicates that the nosewheel air/ground switch went from "ground" to "air" to "ground" within one second followed by a recorded acceleration of +1.9 G. In parallel the data indicates the control column moving to neutral as the nose wheel lowers, then pulled back slightly over half full travel, just before the nose wheel touches down, followed full nose down input, as the nose wheel touches down. This input remains during the nose wheel bounce and roll out of the aircraft. The PF stated that he had pulled the speedbrake lever at what he considered to be a normal rate. He mentioned that this was not the first time he had deployed the Speed Brake manually on landing. He was unable to recall if it was a fully extended or up . He then kept his feet on the rudder pedals to keep control of the aircraft on the runway centerline. Both crews reported that the aircraft nosewheel touched down three times. The flight data records however indicate that this happened two times, once after touchdown of the main gear and then after

the pitch up moment, before settling on the ground. The flight data indicates that the time from main landing gear to nosewheel touchdown was 1.5 seconds. Once the aircraft nose had settled the thrust reversers were deployed. The PF confirmed he had deployed the thrust reversers, however during the interview he could not recall at what stage this was. The PM stated he called "I have control". He stowed the thrust reversers and speedbrake. After vacating the runway, the crew checked the EICAS but there was no message, therefore the taxi was continued to stand.

When asked about position of hands, the Capt stated that as PM he kept his hands on his thighs during an approach and was adamant that he would not have been touching the controls.

At the interview, the engineer was asked about control column inputs after nose wheel touch down. He could not recall any specifics due to being disorientated from the hard landing. On a follow up question regarding the Captain's hands position, he recalled they were on his thighs and shadowing the controls at times, however he felt he did not have a clear view of pilot hand positions at all times.

On arrival at the stand, the Captain was concerned about the state of the nose gear. He instructed the FO to call Maintenance Operations Control (MOC) and obtain information on how to retrieve a hard landing report from ACARS event printout. The engineer on board, went down and conducted an inspection of the nose and main landing gears, as well as the engines. No damage was found. While still inspecting the landing gears, he was alerted by ground staff of a crinkle in the fuselage. He noticed the fuselage damage on walk around and advised the crew accordingly.

On stand, cargo was off loaded normally, no apparent damage to cargo door or cargo hold floor. No cargo had moved nor locks damaged. Cargo was confirmed loaded as per the load plan and a reweigh of the majority of cargo found minimal discrepancy in weights.
Other items noticed during the event were that the panel over the jump seat fell down, the escape reels fell down, water displaced out of toilet and coat hangers fell down.

The DGCA attended and were provided with copies of licenses and medicals. No drug and alcohol test administered.

The crew cooperated with the DGAC inspector and handed over the data for the landing report which indicated 'no hard landing reported' on landing ACARS print off.

On recollection, the crew reported the auto speed brake system was inoperative, and that the auto speed brake non normal checklist only says, 'speed brake ... extend', there is no further details or notes regarding the operation, the speed brake was manually extended, as it has been done before on other occasions.

They cited that a good briefing before the descent was done where the Captain actually mentioned that the only and most likely threat was the MEL item, briefed stable approach criteria and that the crew (including the onboard engineer) were secured with the seat belt and harnesses.

While no conclusion could be drawn as to probable cause of the incident by the crew, they suggested that as a recommendation, the Operating Manuals should include more information about the use of the Speed Brake including manual operation.

1.2 Injuries to Persons

There were no injuries to any persons on board.

1.3 Damage to Aircraft

Damage to the aircraft consisted of wrinkled /buckled fuselage skin at STA 654on both left and right hand side. In addition, the top shell upper pressurized fuselage crown was wrinkled and had buckled damage at STA 654.
Oil traces on the LH main landing gear.
The aircraft was declared unserviceable and was grounded by the Lebanese DGCA.

Detailed position of the damage following Boeing inspections as follows
- Skin panel +654 to 786 and STR-26L TO 17L

- Skin panel +654 to 786 and STR-17L TO 8L
- Skin panel +654 to 786 and STR-8L TO 2R
- Skin panel +654 to 786 and STR-2R TO 8R
- Skin panel +654 to 786 and STR-8R TO 17R
- Skin panel +654 to 786 and STR-17R TO 26R
- Stringers 21L to 17L
- Stringers 16L to 8L
- Stringers 7L to 1R
- Stringers 2R to 7R
- Stringers 8R to 16R
- Stringers 17R to 23R
- Shear ties and stringer Clips
- Frames detail, frame assembly
- Tubing, static lines
- Tubing, instrument lines
- Tubing, smoke detection, Main Deck Cargo
- Bracket assy, cargo ceiling liner support
- Bracket – ECS ducts Main Deck Cargo

Reference: Boeing survey and inspection report attached

1.4 Other damage
Nil

1.5 Personnel information

Captain
Age: 61
Pilot License: ATPL
Medical Expiry date: 26/01/2024
Total Flying Hours: 22144 hrs.
Hours on type: 7728 hrs.
Hours Last 90 Days: 147:16 hrs.
Hours on Duty Prior to Occurrence: 3 hrs.
Hours Off Duty Prior to Work Period: 84:45 hrs.

First Officer
Age: 32
Pilot License: ATPL
Medical Expiry date: 18/06/2024
Total Flying Hours: 4666 hrs.
Hours on type: 3141 hrs.
Hours Last 90 Days: 68.07 hrs.
Hours on Duty Prior to Occurrence: 3 hrs.
Hours Off Duty Prior to Work Period: 84:45 hrs.

1.5 .1 Aircraft Captain

The captain joined DHL on 1st April 2015. He held a valid class 1 medical and had successfully completed all the required company training and courses.

1.5 .2 First officer

The first officer joined DHL on 15th July 2017. He held a valid class 1 medical and had successfully completed all the required company training and courses.

1.5.3 The engineer

Engineer joined DHL on 1st August 2023. He held a valid Medical Fitness of Aircraft Maintenance Certifying Staff, and a valid Aircraft Maintenance License.

1.6 Aircraft Information

1.6.1 General

The aircraft a B767-300BDSF MSN29606 was manufactured in 1999 and was registered in the US as N399AN. It was delivered to a US carrier and flew as a passenger aircraft till 2020 when it was converted to a Cargo aircraft by Israel Aerospace Industries (IAI) . As a cargo aircraft, it was operated by DHL Air (UK). It was acquired by DHL Air International and entered the BCAA registry as A9C- DHAB on 26th June 2023. It had a valid C of A; C of R. other details are below.

Manufacturer: Boeing Company
Type and model: B767-300 BDSF
Cargo Conversion: IAI
Year of manufacture: 1999
Aircraft Serial Number: 29606
Aircraft Line Number: 752
Total airframe time: 84182 hrs
Engine type (number of): CF6-80C2B6 (No. of engines-2)
Maximum Allowable take-off weight: 412,000lbs / 186,880kgs
Total aircraft cycles: 14470
Certificate of airworthiness issued: 22/06/2023
Certificate of Registration issued: 22/06/2023
Date of last check: 18/09/2023 (1 A Check)

1.6.2 Weight and Balance

At the time of landing, it was estimated that the aircraft gross weight was 317062lbs. and the position of the center of gravity (CG) for landing was estimated to have been 27.1% mean aerodynamic chord (MAC). Both of them were within the allowable C of G range for the aircraft i.e. the maximum landing weight of 326,000lbs. and CG envelope between 7% to 37% MAC.

1.6.3 Maintenance and Repair information

A review of the tech log entry pertaining to the speedbrake on this aircraft for a period of 90 days prior to this incident was conducted. Starting from 7th July 2023 until the 18th September 2023 defect descriptions were entered in the Tech log regarding the speedbrake system on 11 occasions. These defects ranged from
- The auto speedbrake inoperative
- Auto speedbrake EICAS message after landing
- Auto speedbrake failure indication during approach for which manual selection was selected after landing.
- Speedbrake not deploying after touchdown.
The resolutions ranged from system operational checks and CB reset.

On 13th September 2023, a techlog entry was made and indicated that at the request of Maintenance Operations Control (MOC), the auto speed brake actuator was removed due to repetitive defects. The actuator was replaced on the same day in accordance with the AMM 27-62-04/201 and tests carried out were satisfactory.

On 15th September 2023, a techlog entry was made and indicated that the speedbrake did not deploy during touchdown. For this defect, the tech log resolution indicates a CB reset, and operational checks carried out satisfactorily.

On 16th September 2023, a techlog entry was made and indicated that the speedbrake did not deploy during touchdown. For this defect, the tech log resolution states operational checks carried out satisfactorily in accordance with AMM TASK 27-62-00-715-002 .

A second entry in the tech log for the speedbrake not deploying was made later on 16th September 2023. Further operational checks were carried out in accordance with AMM 27-62-01-705-002 and AMM 27-62-00-825-022. Both were satisfactory.

A similar entry regarding failure to deploy was recorded on 17th September 2023. On this occasion, maintenance reported via tech log that auto speed brake actuator arming switch S371 adjusted IAW AMM 27-62-00/401 system tests were carried out with air/gnd and autothrottle simulation. Functional tests in accordance with AMM 27-62-00/501 found the system serviceable.

On 18th September 2023, the tech log information indicated that on request from MOC, the auto speedbrake arming switch S371 was replaced in accordance with AMM 27-62-06/201. During test auto speedbrake lever auto deployment to up was intermittent.

On the same day, an entry was made in the tech log and it added that the auto speedbrake system was deferred IAW MEL 27-62-01-02 CAT C. Maintenance procedure carried out IAW Dispatch Deviation Guide (DDG) AMM 27-00-00.
1. "SPEEDBRAKE AUTOSTOW" and "AUTO SPEEDBRAKE" CBS pulled and collared
2. "AUTO SPEEDBRAKE" OVERHEAD ANNUNCIATOR bulbs removed
3. Electr connector removed from SAC and connected to test connector.
It added 'please observe operations procedure. '

Limitations include:
(M)(O) may be inoperative provided:
A) System is deactivated,
B) speedbrake handle forces are verified normal from full down to full up position,
C) AFM decrements are applied if landing performance requires use of auto speed brakes, and
D) Airspeed does not exceed 290 kias, or .84 mach, whichever is lower, when inflight gross weight is in excess of 340,000 lbs (154,545 kg).

With the MEL applied, and in relation to this event additional notes for Operations (O) stated that crew were to extend the speedbrakes manually for rejected landing or take-off. For landing, crew were to carry out the AUTO SPEEDBRAKE non normal checklist (QRH NNC 9.3), by NOT arming the speedbrake lever, and to manually extend the speedbrakes after landing.

1.6.4 Previous hard landings

Between January 2022 and August 2023, there had been on average 1 landing per month above 1.8G. Two of which at BEY. None were identified as having a nose down input during touchdown and no crew trends were identified.

1.7 Meteorological information

The observed weather at OLBA at 16:00 UTC indicated westerly surface winds at 4 knots. It was variable between 240V340. The reported visibility was 10 km or more and few clouds at 2600 ft.
METAR OLBA 181600Z 27004KT 240V340 9999 FEW026 28/22 Q1009 NOSIG=

1.8 Aids to navigation

The approach runway 16 was via the ILS system. The airport has a VASIS. The ILS and VASIS were serviceable at the time of the event.

1.9 Communications

The crew were in communications with ATC using the VHF radios. The ATC recorded data and flight data which contains this information has not been made available to the airline.

1.10 Aerodrome information

1.10.1 General

Rafik Hariri International airport is located at N33°49.14' / E35°29.40' and at a field elevation 85.0 feet AMSL. The airport is managed and operated by the Directorate General of Civil Aviation (DGCA), who are also responsible for provision of Air Traffic Management in Lebanon. It has three runways. Runway 16/34 is oriented 162/342° magnetic, measures 11138 feet long by 148 feet wide. Runway 16 has a displaced threshold.

The DHL OM-C lists Beirut as a Category A in both Airport Category and Airport competence.

Due to the loss of GPS signals in the area, crew are requested to not plan for any RNAV/GNSS approaches until further advised. A careful study of the NOTAMs is essential.

1.10.2 Runway 16 ILS Approach

Due to reports of GPS jamming in the area, ILS is the company preferred approach procedure. The approach is flown over the sea and has platform altitude 2000 ft AMSL. The descent point is at 6.3 NM ILS DME with a minimum descent altitude (MDA) of 420 feet AMSL or 333 feet AGL. The runway centerline is offset 2ft to the left. The touchdown elevation is 12 ft AMSL. The localizer coverage is restricted to 30° left of CL.

1.10.3 Other visual aids

The runway is equipped with VASIS oriented at 3 degrees and located on the left.

1.11 Flight Recorders

1.11.1 General

The aircraft was equipped with an L3 Harris FA2100 Digital Flight Data Recorder (DFDR) and an L3 FA2100-1020-99 Cockpit Voice Recorder (CVR). Both were removed from the aircraft and handed over to the DGCA investigator. The DFDR and the CVR were successfully downloaded by the BEA at Le Bourget in Paris by the The Investigator In Charge (IIC), another member of the investigation team and the Director Safety and Ground Ops at DHL on October 3, 2023.

However, on arrival on stand, the associated CB for the CVR was not pulled, after engine shutdown. Since the CVR has only two hours of recording, the audio data was overwritten.

The data from the wireless quick access recorder (WQAR) was also downloaded to assist with the data analysis.

1.11.2 Flight data (QAR) review

The following was obtained from an initial review of the WQAR.

Control Column Movement
Based on pre-flight control check, the following are the control column max inputs
Max Nose Up – +11 deg
Max Nose Down - -7deg

The recorded parameter is both Cpt and FO control column movement. The columns are physically joined and there are no individual sensors for movement and force for the FO column.

Approach.
The flight data indicates passing 409 ft the autopilot was disengaged and was then followed by auto-throttle disengaged. Thereafter the approach remained stable with minimal flight crew inputs.
At 20ft aal, the rate of descent was -650 ft/minute with a Vref +4.5 kts.

Main gear touch down.
The aircraft is being 'flared' for the touch down. The left main landing gear touched down (vertical acceleration: +1.32 G) with the pitch angle of about +3.2°, roll angle of about -1.1°, and airspeed of 150 kt. The right main gear touched down one second later.

When main gear touches down, the Rad Alt continued decreasing from -2ft to -6ft RA throughout this period with no period of increase, the control column correspondingly moving to a neutral position, from +4 deg to +1 deg over a 1.5 second period. Then within 1 second, the control column increases +5.9 deg, indicating being pulled back just before the nose gear touches down.

Nose gear first touch down.
As the nose gear squat switch "Gear (N) On Ground" records "Ground", the control column is push forward past -6.94 deg.
The nose gear oleo compresses and touch down is recorded with a vertical acceleration of +1.771G, which is measured from the accelerometers located in the main gear wheel well area.

The pitch attitude was initially 0.5 degrees at nose gear touch down, decreasing to -0.5 degrees minimum, then increasing through +1.6 degrees. The roll angle from 0° to the right 0.4°.

At this time speedbrake handle parameters (C), (L), (R), (MCP) indicate that the handle was moved from approximately 4 degrees to 96 degrees, indicating the speedbrake was fully deployed manually, moving at a similar speed to an auto deployment. It remains at this value for the landing roll until when stowed.

The "Gear (N) On Ground" recorded "Ground" and about 1 second after that, it is recorded "Air", as the nose gear bounces. The pitch increases to +2.5 degrees momentarily before decreasing with a recorded nose down push on the control column recorded as increasing to -7.29 deg.

Nose gear second touch down.
Thereafter the "Gear (N) On Ground" squat switch records "Ground", with +1.91 G vertical acceleration at touchdown. The control column pitch input recorded as –7.29 deg and this lasted for more than 15 seconds before decreasing slightly.

Thrust Reverser deployment.
Soon after the Eng (1) Thrust Reverser "In Transit" followed by Eng (1) Thrust Reverser "Deployed" and Eng (2) Thrust Reverser "In Transit". This was followed by Eng (1) and Eng (2) Thrust Reversers".

Landing roll
Roll out was completed with a full nose down input on the control column, reducing from -7 to -6 deg. Just before the aircraft vacates the runway, the control column returns to a neutral position.

The aircraft continues and taxis to stand.

1.12 Wreckage and Impact Information
The damage is detailed in section 1.3 damage to aircraft above.

1.13 Medical and Pathological Information

Not applicable.
1.14 Fire

There was no evidence of fire before or after the occurrence.

1.15 Survival Aspects

Not applicable

1.16 Test and Research

1.16.1 Industry B767 hard landing events with damage

There have been previous hard landing events by other B767 operators where damage to the crown of the upper fuselage occurred. Due to three accidents, two in 1992 and one in 1993, the NTSB and Boeing in conducted a review, which concluded that the accidents had been due to:
- Excessive nose down elevator commanded
- Bounce after initial main gear touchdown, and
- Operating in moderate to high crosswinds.

Responding to the three accidents, the aircraft manufacturer took the following countermeasures. (Ref: Japan Transport Safety Board investigation AA2016-6).
- Change of metering pin to reduce the maximum impact on nose landing gear
- Strengthening of the structure of the forward fuselage upper crown
- Creation of training materials (video) for pilots of Boeing 767 and distribution of information magazines to notify relevant parties of a possibility that strong nose landing gear touch-down could cause damage on the fuselage.

Further detail was found in two further accident reports regarding the action taken by the manufacturer. (Ref: AAIB Bulletin 5/2012 / NTSB Accident report DCA09FA045)

Nose Gear Metering Pin
The 767-300 nose gear metering pin was further optimized to absorb the energy produced during over-derotation events, thereby lowering the load on the nose gear. The metering pin device controls the flow of hydraulic fluid within the nose gear oleo strut. The modified design was incorporated into production airplanes in August 1994 and is available for retrofit on earlier 767-300s. Being manufactured in 1999, the accident airplane had this modification installed.

Forward Fuselage Structural Strengthening
The upper crown stringers on the forward fuselage of the 767-300 were strengthened in the area where buckling often occurred following over-derotation. The modified design was incorporated into production airplanes in January 1995. Being manufactured in 1999 the accident airplane had this modification installed.

Flight Crew Training Aid
Boeing produced a training video to increase flight crew awareness of the potential for both nose gear and airframe damage as a consequence of over-derotation. The nine-minute video serves as a refresher for flight crews and was sent to all Boeing airline customers. The accident flight crew had not viewed the video.

In reviewing this incident, the Boeing training video regarding de-rotation was found on the internet. (https://www.youtube.com/watch?v=EuxBP4t8B30). This video was subsequently shared with the DHL Flight Crew Training department for their review and dissemination to crew.

A further accident involving nose down input during landing occurred on 29th July 2023, the NTSB report refered to previous accidents and existing guidance in the Flight Crew Training Manual. No new recommendations were raised. (Ref NTSB Accident report DCA23LA384).

1.17 Organizational and Management Information

1.17.1 DHL ME

DHL Aviation EEMEA B.S.C. (C), is a cargo airline based in in the Kingdom of Bahrain. It employs 298 staff to dispatch, fly and maintain a fleet of Boeing 767-300 freighters operating under a Bahraini AOC, based at Bahrain International Airport.

DHL Aviation is the central platform for DHL Air Network Operations in the Middle East. It is wholly owned by Deutsche Post and operates the group's DHL-branded parcel and express services mainly in the Middle East and North Africa, also with flights to Europe, India and Far East.

The airline began dedicated cargo flights between Bahrain and Riyadh in 1979 with a Fokker F27 Friendship. In subsequent years, larger jet aircraft were introduced starting with B727's in 2004, then progressing to B757-200 in 2010, B767-200, then B767-300 freighter, with each introduction the preceding aircraft were retired from the fleet.

The airline currently has a total of 10 B767-300 freighters registered on the AOC, having been introduced from March 2021. These are a combination of Boeing (BCF) and IAI (BDSF) conversions.

1.17.2 Operator's Safety Management System

The VP Airline ME is the Accountable Manager, responsible for the management and operation of the

AOC. The senior management reporting to the Accountable manager consists of Postholders for Flight Operations, Technical , Flight Crew Training, Security, Quality and Safety and Ground Operations.

The Post Holders for Quality and Safety have an open line of communication with senior management, to ensure quality and safety topics are afforded the proper level of attention and solutions are implemented in a timely manner.

This is facilitated by several means including reviews of reported events at Monthly Safety Action Groups, be they from the crew reporting or as flagged by the Flight Data monitoring program.

The airline has certification under the IATA Operational Safety Audit (IOSA) Programme, including confirmation of the implementation of the Safety Management System.

1.17.2 Flight Operations Manual – A

2.1.6 Preservation of Flight Recorder and Cockpit Voice recorder Recordings (ANTR 1.160,1.700,1.705, 1.710)

The Flight Data Recorder will be capable of retaining data during at least the last 25 hrs of operation except that 1 hr of the oldest recorded material may be erased during routine testing and maintenance. The CVR shall be capable of retaining information for at least the last two hours of operation. Retrieval and conversion of stored data, when required, is carried out in conjunction with the DHL Aviation Engineering Dept.
Following an accident or an incident which is subject to mandatory reporting, or when the Authority so directs, the original recorded data relating to that accident or incident will be preserved for a period of 60 days, unless otherwise directed by the investigating authority.

11.4.2 Preservation of Flight Recorder Recordings (ANTR 1.700)

The CVR and FDR are usually removed for the investigating authority after an accident or serious incident. If the crew or attending engineer(s) know or suspect that the incident may be classified as 'serious' they should ensure that the CVR and FDR are disabled as soon as possible to prevent data being overwritten. Replacements must be installed before the aircraft is operated again. If not already held by the investigating authority, removed recorder(s) should be returned to BAH (Director Safety and Ground Operations) as a priority.

1.6.3.4 During Flight

The Commander will ensure that:
......
Also, the Commander will not permit:
a. A flight data recorder to be disabled, switched off or erased during flight or recorded data to be erased after flight in the event of an accident or an incident subject to mandatory reporting.
b. A cockpit voice recorder to be disabled or switched off during flight unless he believes that the recorded data, which otherwise would be erased automatically, should be preserved for incident or accident investigation nor permit recorded data to be manually erased during or after flight in the event of an accident or incident subject to mandatory reporting.

1.17.3 Flight Operations Manual - B

OM-B 0.1.5.1 Normal Procedures
It states that Normal procedures are performed from recall and follow a panel scan pattern. These procedures are designed to minimise crew workload and are consistent with new flight deck technology. All procedural information is task orientated.

In-flight the PF, whether in the LHS or RHS, may operate the speed brakes, but must keep his hand on the lever whilst they are in use. On the ground the speedbrake will only be operated by the LHS pilot.

0.1.5.2 Supplementary Normal Procedures

This section contains normal procedures that are accomplished as required, rather than routinely performed on each flight.

0.1.5.3 Non-Normal Procedures

Non-Normal Procedures are found in Section 3 or the QRH in hard copies of this manual. The introduction to Non-Normal Procedures is found in Section CI.2.1.

1.17.4 Flight Crew Training Manual

Chapter 6.4 speedbrakes

The speedbrakes spoil the lift from the wings, which places the airplane 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 speedbrakes can be fully raised after touchdown while the nose wheels are lowered to the runway with no adverse pitch affects. 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.
Pilot awareness of the position of the speedbrake lever during the landing phase is important in the prevention of over-run. The position of the speedbrakes should be announced during the landing phase by the PM. This improves the crew's situational awareness of the position of the speedbrakes during landing and builds good habit patterns which can prevent failure to observe a malfunctioned or disarmed speedbrake system.

Chapter 6.8 Flare and Touchdown Flare and Touchdown

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. Begin with a stabilized approach on speed, in trim and on glide path.

Note: When a manual landing is planned from an approach with the autopilot engaged, the transition to manual flight should be planned early enough to allow the pilot time to establish airplane control before beginning the flare. The PF should consider disengaging the autopilot and disconnecting the autothrottle 1 to 2 nm before the threshold, or approximately 300 to 600 feet above field elevation.

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 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. A touchdown attitude as depicted in the figure below is normal with an airspeed of approximately VREF. Ideally, main gear touchdown should occur simultaneously with thrust levers reaching idle.
Avoid rapid control column movements during the flare. If the flare is too abrupt and thrust is excessive near touchdown, the airplane tends to float in ground effect. Do not allow the airplane to float or attempt to hold it off. Fly the airplane onto the runway at the desired touchdown point and at the desired airspeed.
Note: Do not trim during the flare. Trimming in the flare increases the possibility of a tail strike.

Chapter 6.24 Landing Roll

	Avoid touching down with thrust above idle since this may establish an airplane nose up pitch tendency and increase landing roll. 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. To avoid the risk of a tail strike, do not allow the pitch attitude to increase after touchdown. However, applying excessive nose down elevator during landing can result in substantial forward fuselage damage. Do not use full down elevator. Use an appropriate autobrake setting or manually apply wheel brakes smoothly with steadily increasing pedal pressure as required for runway condition and runway length available. Maintain deceleration rate with constant or increasing brake pressure as required until stopped or desired taxi speed is reached. 1.18 Additional information 1.18.1 The Aircraft Maintenance Manual (AMM) A hard landing is considered to have occurred if the pilot considers a hard landing has occurred or when an aircraft lands on its main landing gear and the peak recorded vertical acceleration exceeds 1.8 g, if recorded with at least eight samples per second However, for a hard nose landing, the peak recorded vertical acceleration can be significantly less than 1.8 g Chapter 05-51-01 states that a structural examination is required if the aircraft has experienced a hard landing.

2. Analysis

2.1.Analytical Interpretation of data

Analysis	This analysis will review the events that preceded and led to the hard landing and include, the MEL, aircraft status, flight crew procedures and training, the deployment of thrust revers and speedbrakes. An initial Safety Recommendation(s) will be made. 2.1 Dispatch and release of flight with MEL The aircraft had a valid airworthiness certificate and had been maintained and inspected prior to this flight. Due to a recurring fault in the Auto Speed Brake System; the Auto Speed Brake System was deactivated in accordance with the MEL 27-62-01-22 for an aircraft with a Speed Brake Load Alleviation System installed. With the MEL applied, and in relation to this event additional notes for Operations (O) stated that crew were to extend the speedbrakes manually for rejected landing or take-off. For landing, crew were to carry out the AUTO SPEEDBRAKE non normal checklist, which states 'Manually extend speedbrakes after landing'. 2.2 Pilot actions in preparation for landing In preparation for the landing, the crew configured the airplane according to the company's stabilized approach procedure, for a flaps 25 landing. Since the auto speed brake function was deactivated, the crew elected to pull the speedbrake lever on landing as per the non normal checklist. This task was to be accomplished by the PF who was occupying the right hand seat. The PM had stated he wanted to pull the speedbrakes but in discussion had agreed to PF's request to pull the speedbrakes. The crew discussed the deployment of the speeddbrake several times including before take-off and top of descent. The Captain emphasize that it needed to be 'deployed slowly'. As speedbrake was inoperative it was not armed. The operation of the speedbrake was not in accordance with the OM-B 0.1.5.1 Normal Procedures which stated that 'on the ground the speedbrake will only be operated by the LHS pilot'. 2.3 Pilot actions during the landing. With a planned manual landing, the autopilot was disengaged and was then followed by auto-throttle disengaged at approx. 409ft aal. Data indicates that the left main landing gear touched down (vertical acceleration: +1.32 G) with the pitch angle of about +3.2°, roll angle of about -1.1°, and airspeed of 150 kt. The right main gear touched down one second later. With the main gears on ground, speed brakes are manually deployed at a comparable rate to auto speedbrake deployment. FCTM 6.4 states 'The speedbrakes can be fully raised after touchdown while the nose wheels are lowered to the runway with no adverse pitch affects'. The nose wheel briefly touches down at +1.771G, 1.5 seconds after the main gear. Control column movements, result in full nose down input, the nose wheel touches down again at +1.91G. FCTM 6.24 states '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 technique of using full nose down control column input was further evaluated by the DHL Safety Department. Further information is documented in the Safety Action Taken section of this report. 2.3.1 Deployment of the thrust reversers and speedbrakes. Speedbrake handle parameters indicate that the handle was moved from approximately 4 degrees to 96 degrees. It remained at this value for the landing roll until when stowed. The reversers were deployed normally during the landing roll out. The manual deployment of the speedbrakes was from by the PF seated on the right-hand seat. To do so, the PF had to remove his hand from the control wheel, reach across the Control Stand, and behind the throttle, and pull the speedbrakes. While the PF mentioned he had performed such actions on previous flight, it was not determined if these were conducted when acting on PF role.

The reported slight left deflection on the control wheel, was likely due to the reaching across and the uncoordinated movement of pushing the control column down, while simultaneously pulling the speedbrake.

2.3.2 Damage to the aircraft

As the aircraft nosewheel returned to the ground for a second time following the initial pitch up, the control pitch increased to a full nose down due to crew input. The derotation was less than 1.5 seconds; that is from when the main landing gear to nosewheel touching down at +1.91G. This exceeded the AMM hard landing structural inspection limit of +1.8G. The damage to the crown of the upper fuselage occurred due to the full nose down input from the initial bounce.

As mentioned in the Industry B767 hard landing events with damage section, the damage on the aircraft was consistent with those from similar hard landing events by other B767 operators and was likely due to a combination a nose gear bounce after main gear touchdown, followed by an excessive nose down elevator input.

The Boeing production modifications implemented due previous accidents of this nature, had been implemented on this aircraft, further more the B767-300 IAI STC, does not require any further strengthening in the area of the fuselage that was damaged.

2.3.3 Preservation of recordings

OMA 11.4.2 states 'If the crew or attending engineer(s) know or suspect that the incident may be classified as 'serious' they should ensure that the CVR and FDR are disabled as soon as possible to prevent data being overwritten'. Upon reaching the stand, the crew performed the engine shutdown procedure unaware of the aircraft damage. Subsequently the engineer on initial walkaround alerted the crew to the aircraft damage.

The crew did notify the company regarding the accident, and that information was relayed for securing the DFDR and CVR as per the DHL Emergency Response Manual procedures. However, the associated CB for the CVR was not pulled, after engine shutdown. Since the CVR has only two hours of recording, the audio data was overwritten.

The AAIB Bulletin 5/2012 discuses the original conflicting legislation about the conditions that would pertain to the CVR CB being pulled. The report concluded that further auditing of procedures were required to ensure they were robust.

More recently NTSB recommendation A-18-31 detailed in a NTSB Letter 31 Jan 2024, recommends the fitment of 25hr recording CVR's due to losses of recordings in several accidents due to the CB not being pulled.

The WQAR was successfully downloaded and used in providing the initial flight data review. The DFDR was read out at the BEA institute. The delay in securing the CVR resulted in loss of critical information related to crew discussion and verbal actions during the incident.

3. Findings

3.1.Findings

Findings	1. The airplane possessed a valid Certificate of Airworthiness and had been maintained in accordance with the relevant regulations. 2. The airplane had taken off from Bahrain with a MEL item 27-62-01-02 Flight Controls, Auto Speed Brake System. 3. The pilots were licensed by the Bahrain CAA and experienced on type. 4. The documents received by the Flight Crew prior to departure, including weather information, were in accordance with the relevant requirements. 5. The initial touchdown was normal, however bounce of the nose wheel occurred, followed by a fast derotation. 6. A momentary nose-up column input, pitching moment during speedbrake deployment, and nose gear rebound were all contributing factors to the nose gear bounce. Pitch attitude reached around +2.5 degrees before decreasing again as a result of the sustained column push at -7 degrees. The negative column deflection (push) was maintained for approximately 20 seconds. 7. Neither crew member recalls making the nose down input on the control column 8. The damage to the crown of the upper fuselage occurred due to the full nose down input. FCTM 6.24 highlights this risk of structural damage due nose down inputs during landing. 9. The PF seated on the RHS operated the speedbrake. The Non Normal checklist for Autospeed failure does not specify which crew member deploys the speedbrake. The OM-B 0.1.5.1 Normal Procedures stated that on the ground the speedbrake will only be operated by the LHS pilot. 10. The second touch down of the nose gear was at +1.91G, which exceeded the AMM hard landing structural inspection limit of +1.8G. 11. The damage to the aircraft is consistent with previous accidents of this nature, where there is a high g force through the nose gear on landing. 12. The Boeing production modifications implemented due previous accidents of this nature, had been implemented on this aircraft. 13. The B767-300 IAI STC, does not require any strengthening in the area of the fuselage that was damaged. 14. The CVR CB was not pulled out immediately following the identification of the damage, as required by the operator OMA. 15. As more than 2hrs had passed by the time the CB was pulled, this resulted in the loss of critical voice data.

3.2.Causes

3.2.1.Contributory Factors

Contributory Factors	Contributory to accident was the aggravated derotation when the speedbrake handles were moved up. The crew's increased focus on this task, combined with the additional stress from experiencing the landing G forces, resulted in an inappropriate reaction by a crew member, an action learnt from a previous aircraft type or trainer.

3.2.2.Root Cause

Root Cause	The likely cause of the accident was the excessive nose down elevator input, following a nose gear bounce.

4. Conclusions	
Conclusion	The likely cause of the accident was the excessive nose down elevator input, through the control column, following a bounce of the nose wheel upon landing. The technique is likely to have been used by one of the pilots due to natural human instinct to revert to type when under a high stress scenario. The origin of the technique is likely due to previous experience or training related to aircraft requiring nose down input during landing. The second touch down of the nose gear was at +1.91G, which exceeded the AMM hard landing structural inspection limit of +1.8G. The result was structural damage to the crown of the aircraft consistent with preceding accidents involving nose down input during landing.

5. Safety Action Taken

5.1.Safety actions proactively taken during course of investigation

Safety action	DHL actions following the accident. The crew were removed from duty and subsequently undergone successful training. They were returned to normal flight allocations and duties. The Boeing training video on aircraft derotation was forwarded to the DHL Flight Crew Training for review. The DHL flight crew training have incorporated lessons learned from this event. The DHL Safety department included excessive elevator input parameter in the flight data program for detection. Following this, a detailed analyses found that a number of crew were making nose down input after nosewheel touchdown. Crew members were contacted, and the safety risk was tabled at the Flight Safety action Group. Subsequently, a waiver of anonymity was obtained as per the SMSM protocol, and the identity of the top 10 crew involved was provided to the training department. The Training department reported they will reiterate to the crew the correct procedures for derotation as per the FCTM. While training has incorporated aspects of awareness to nose down inputs during landing, those crew who use this technique were interviewed by the Safety Department, which found that they had used this technique on their previous aircraft type or been taught this from their previous company's trainer, who used this on 'their' previous aircraft type. Flight Operations requested to inform trainers of this finding and while training of new joiners and recurrent training, to note if this technique is used, and to provide remedial training as appropriate. Effectiveness of this will be measured through associated event in Flight Data Monitoring.

6. Safety recommendations

Recommendation 1

Mitigation required	Yes	**Due Date** (if applicable)	2025-06-30 05:53
Risk Rating	Safety relevant	**This risk should be**	treated
Severity	Major (3)	**Probability**	Occasional (4)

Category	Incidental Costs
Title	Cockpit Voice Recorder (CVR): Retention of critical data
Recommendation	The loss of CVR data resulted in loss of critical information related to crew discussion and verbal actions during the incident.
Mitigation required	Yes
Responsible(s)	Technical Director
Required mitigation	Engineering requested to review and consider retrofitting company fleet with CVRs having 25-hour recording duration. (Appendix Ref: NTSB Letter 21 Jan 2024). Following review, provide an implementation plan.

Recommendation 2

Mitigation required	Yes	**Due Date** (if applicable)	2025-03-31 05:55
Risk Rating	Safety relevant	**This risk should be**	treated
Severity	Major (3)	**Probability**	Remote (3)

Category	Reputational Impact
Title	Cockpit Voice Recorder (CVR): Procedures for protection of recordings
Recommendation	The loss of CVR data resulted in loss of critical information related to crew discussion and actions during the incident.
Mitigation required	Yes
Responsible(s)	Director Flight Operations, Director Safety and Ground Ops, Technical Director
Required mitigation	Safety, Flight Ops and Engineering requested to review and consider amending tasks and procedures for removal, downloading and securing of CVR for investigation. (Appendix Ref: AAIB Bulletin 5/2012)

Recommendation 3

Mitigation required	Yes	**Due Date** (if applicable)	2025-03-31 05:56
Risk Rating	Safety relevant	**This risk should be**	treated
Severity	Hazardous (4)	**Probability**	Improbable (2)

Category	Flight Effect
Title	Flight crew training

Recommendation	While training has incorporated aspects of awareness to nose down inputs after landing, those crew who use this technique are believed to have seen this from their previous trainer's aircraft type before joining DHL.
Mitigation required	Yes
Responsible(s)	Director Safety and Ground Ops, Senior Manager Flight Crew Training
Required mitigation	Flight Operations requested to inform trainers of this finding and while training of new joiners and recurrent training, to note if this technique is used, and to provide remedial training as appropriate. Effectiveness of this will be measured through associated event in Flight Data Monitoring.

Recommendation 4

Mitigation required	Yes	**Due Date** (if applicable)	2025-04-30 05:54
Risk Rating	Safety relevant	**This risk should be**	treated
Severity	Major (3)	**Probability**	Improbable (2)

Category	Flight Effect
Title	Manual speedbrake deployment
Recommendation	The incident crew discussed on several occasion, who would deploy the speed brake manually. OM-B 0.1.5.1 Normal Procedures state that 'on the ground the speedbrake will only be operated by the LHS pilot'. Non normal procedures do not define which pilot deploys the speed brake on landing.
Mitigation required	Yes
Responsible(s)	Chief Pilot
Required mitigation	Flight operations to review procedures regarding manual speed brake deployment to ensure clarity as to each pilots role.

Recommendation 5

Mitigation required	Yes	**Due Date** (if applicable)	2025-06-30 05:56
Risk Rating	Safety relevant	**This risk should be**	treated
Severity	Major (3)	**Probability**	Improbable (2)

Category	Reputational Impact
Title	Review of external draft final report
Recommendation	The Lebanon DGCA have yet to publish a draft final report on the incident. When published, DHL will be accorded the opportunity to review and provide comments before the final investigation report is published.
Mitigation required	Yes
Responsible(s)	Director Safety and Ground Ops
Required mitigation	Director Safety and Ground Operations to lead the review of the draft final report with other departments.

7. Signatories

7.1. Signatory

Signatory	Staines, Gavin
Type of signatory	Lead Investigator

Appendix

Other files

AAIB Bulletin 5_2012_B763_G-OOBK.pdf	JTSB Safety Investigation AA2016_6.pdf
NTSB Final Report DCA09FA045.pdf	NTSB Final Report DCA23LA384.pdf
NTSB Letter 31 Jan 2024_FAA 25-Hour Cockpit Voice Recorder (CVR) Requirement, New Aircraft Production.pdf	