OFICINA DE INVESTIGACIÓN DE ACCIDENTES AÉREOS (OFINVAA)

ACCID-015-N372CM-2024

FINAL REPORT

ACCIDENT
Registration: N372CM
Aircraft: Manufacturer: BOEING /Model: 767-338 /Serial Number: 25575
Date of occurrence: March 23, 2024
Location of Occurrence: Runway 21R, Tocumen International Airport.
Coordinates: 09° 05” 30’ N & 079° 22” 33’W

WARNING

This Final Report reflects the results of the technical investigation conducted by the Civil Aviation Authority through the Aviation Accident Investigation Office (OFINVAA) in relation to the event under investigation, in order to determine the probable causes and contributing factors that led to it. It also makes operational safety recommendations to prevent the recurrence of similar events and improve operational safety in general.

Based on Articles 105, 106, and 109 of Law 21 of January 29, 2003, which regulates Civil Aviation, and Section 3.1, Chapter 3, of Annex 13 of the Chicago Convention on International Civil Aviation, this technical report is prepared by the Civil Aviation Accident Investigation Office of the Civil Aviation Authority in relation to the circumstances, causes, and consequences of an aviation accident under investigation.

Therefore, no content of this Final Report, and in particular the conclusions, probable causes, contributing factors, and operational safety recommendations, is intended to assign blame or liability.

Consequently, the use of this Final Report for any purpose other than the prevention of future aviation accidents and incidents, and especially for legal or judicial purposes, is contrary to the purposes of operational safety and may constitute a risk to the safety of operations.

ABBREVIATIONS

AAC	Civil Aviation Authority of Panamá
OFINVAA	Air Accident Investigation Office of Panamá
AOM	Aircraft Operating Manual
APU	Auxiliary Power Unit
ARC	Abnormal Runway Contact
ELT	Emergency Locator Transmitter
FAA	Federal Aviation Administration
FOM	Flight Operation Manual
FTM	Flight Training Manual
GA	Go Around
Kt	Knot
LT	Local Time
NTSB	National Transportation Safety Board
ICAO	International Civil Aviation Organization
S/N	Serial Number
UTC	Universal Time Coordinated
PF	Pilot Flying
PM	Pilot Monitoring
QRH	Quick Reference Handbook
VFR	Visual Flight Rules
RACP	Panamá Civil Aviation Regulations
RCC	Rescue Coordination Center
RNAV	Area Navigation
SAR	Search and Rescue
SOP	Standard Operating Procedures

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SYNOPSIS

Aircraft:	Boeing
Model:	767-338
Serial Number:	25575
Date and time of the accident:	March 23, 2024, 16:15:32 Local Time, 21:15:32 (UTC)
Location:	Runway 21R, Tocumen International Airport
Type of operation:	Regular commercial flight - Cargo
Souls on board:	Two (2) crew members
Operator:	ABX Air



Picture No.1 – Photo of the aircraft

On March 25, 2024, at 10:00 a.m. local time, the head of the Air Accident Investigation Office (**OFINVAA**) received notification from the aviation safety department about an incident that occurred at Tocumen International Airport on Saturday, March 23, in which an aircraft suffered a tail strike during landing.

The head of OFINVAA informs the group of investigators to go to the airport to begin the investigation process.

1. FACTUAL INFORMATION

1.1 Flight summary

On March 23, 2024, the Boeing 767-338 aircraft, registration N372CM, flight number ABX 901, was scheduled to perform a regular cargo flight with two crew members on board, flying from Miami (KMIA) to Tocumen International Airport (PTY). The flight departed Miami approximately four hours late due to weather conditions at the departure airport, with lightning near the field interrupting ramp service on several occasions. Once cleared for takeoff and subsequent taxiing to the active runway, the taxi time was approximately 45 minutes, 30 minutes of which were due to ATS control requiring a mile separation from a LATAM aircraft ahead.

For the route, the captain was the pilot in command of flight commands, or Pilot Flying (PF), and the first officer was the pilot in charge of monitoring, or Pilot Monitoring (PM).

The flight proceeded without incident. The crew had planned to land on runway 03L, but due to the prevailing weather conditions at the time, approach control indicated a change in the runway in use, and the crew decided to use runway 21R, changing their trajectory to perform an RNAV approach for runway 21R.

Panama control provided them with meteorological information and instructed them to hold at VOR DME 210 on the left or RNAV GPS 21 on the right.

The aircraft began its approach to runway 21R, following the descent profile in accordance with the RNAV (GNSS) /RWY 21R chart.

During landing on runway 21R, during the flare maneuver, the aircraft suffered abnormal contact with the runway, causing a tail strike at approximately 16:15:32 local time (LT).

After landing, the aircraft proceeded to cargo position 710 at approximately 16:20 local time (LT), where it was inspected for damage. It then moved autonomously to remote area 512 near Terminal 2 to await inspection by maintenance personnel.

The accident occurred at 16:15:32[1] LT in daylight and under visual meteorological conditions (VMC). The occupants of the aircraft were not injured and the aircraft sustained significant damage.

The Panama Air Accident Investigation Office (OFINVAA) was notified of the incident two (2) days after it occurred by the aviation safety authority. The head of OFINVAA immediately sent two (2) investigators to begin the work of inspecting and collecting

[1] The time of the accident, 4:15:32 p.m., was taken from the airport's security cameras.

evidence at the scene of the incident, in accordance with the provisions of Panama's civil aviation regulations (RACP Book XXVI Part I).

Following the provisions on Aircraft Accident Investigation contained in Annex 13 of the International Civil Aviation Organization (ICAO), OFINVAA notified the accident to the National Transportation Safety Board (NTSB) of the United States of America, as the State of registry, operator, designer, and manufacturer of the aircraft, and to the International Civil Aviation Organization (ICAO).

An accredited representative from the United States was appointed but did not travel to the site of the accident, along with technical advisors from the manufacturer Boeing, the cargo company ABX AIR, and the FAA (Federal Aviation Administration).

1.2 Injuries to persons

Injuries	Crew	Passengers	Others	Total
Fatal	**-**	**-**	**-**	**-**
Serious	**-**	**-**	**-**	**-**
Minor/None	**2**	**-**	**-**	**2**
Total	**2**	**-**	**-**	**2**

1.3 Damage to the aircraft

1.3.1 Damage Assessment study

A damage assessment study was conducted by a third party Company and the complete damage assessment report detailed the recommended repairs and structural modifications.

1.3.2 Airframe

Because of the impact of the lower fuselage section against the runway surface, significant damage was caused to the aircraft structure:

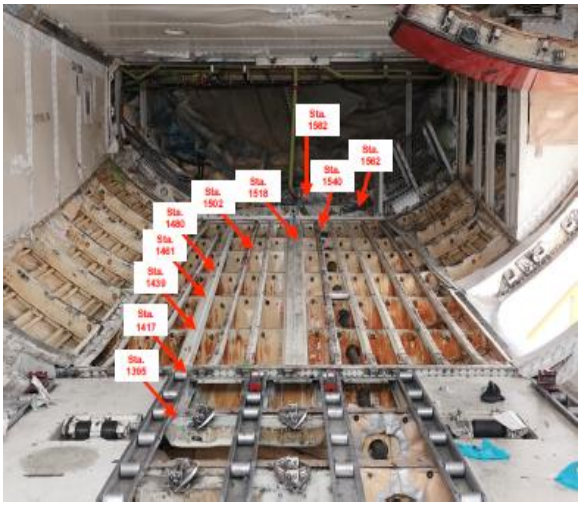
External damage to the aircraft is located in the area between Body Station 1392 and Body Station 1728 on the longitudinal axis and between left and right stringers 36. The internal damage correlates with the external damage, with the most significant damage being to the aft pressure bulkhead and the subfloor structure in the rear cargo compartment. There is damage to the formed and forged frames in the rear compartment and secondary damage to the center box of the horizontal stabilizer and the nut at the end of the leveling screw due to the displacement of the tail skid shock absorber strut/actuator and the severing of the separation cables.

An external inspection of the APU was carried out because the APU was reported as INOP after the tail strike.





Picture No.2, 3 – Damage to the rear lower part of the fuselage.





Picture No.4, 5 – Damage to the aircraft

1.3.3 Engine

No damage.

1.4 Other damage

None.

1.5 Personnel information

1.5.1 Captain in command

Nationality: American, Airline transport pilot: multi-engine land aircraft, type ratings B-757, B-767, L-188 (date of issue: August 18, 2017)

Medical certificate: first class; date of examination: October 2, 2023; limitations: must wear corrective glasses to meet vision standards at all required distances.

According to the pilot's statements in the interview at the time of the accident, he was wearing his prescription glasses.

According to records provided by the company, his experience:

Total flight time: 9700.7 hrs.

B767 flight hours: 8582.4 hrs.

30 days before the accident: 43.42 hrs.

Final competency check: May 4, 23

Last 90 days: 136.66 hrs.

Last 72 hours: 5.73 hrs.

Last 24 hours: 5.73 hrs.

Deadline for the next competency check: June 24

The last update or recurring update from the captain on the aircraft was on January 25, 2024.

Note: The operator provided the captain flight activity hours.

1.5.2 First officer

Nationality: American, Airline transport pilot: multi-engine land aircraft, commercial privileges: single-engine land aircraft, type ratings B-757, B-767, SD-3 (date of issue: January 13, 2022).

Medical Certificate – First class – examination date June 2023 – limitations: Must wear corrective glasses to meet vision standards at all required distances. According to the pilot's statement at the time of the incident, he was wearing corrective glasses.

According to records provided by the company, his experience:

Total flight time: 3,300 hrs.

B767 flight hours: 1043.3 hrs.

30 days before the accident: 35.75 hrs.

Final competency check: July 14, 23

Deadline for the next competency check: August 24

Last 90 days: 55.78 hrs.

Last 72 hours: 9.45 hrs.

Last 24 hours: 6.12 hrs.

The last update or recurrence of the first officer on the aircraft had been on February 6, 2024.

Note: The operator provided the first officer's flight activity hours.

1.6 Aircraft information

1.6.1 Information about the aircraft

Aircraft	
Registration	N372CM
Manufacturer	Boeing
Model	767-338
Serial number	25575
Year of manufacture	1992
Engine Type	Turbofan
Maximum take-off weight	380,000 lbs.
Cycles	33,028
Total time	97,363:09 hrs.

Current airworthiness certificate at the time of the accident.

1.6.2 Engine information

Engines		
	#1	**#2**
Manufacturer	General Electric	General Electric
Model	GECF6-80C2B6	GECF6-80C2B6
Serial number	----	----

Time Since New (TSN)	----	----

1.6.3 Weight and balance

The weight of the aircraft at the time of the incident was calculated using the following values:

		WGT LB
Basic operating WGT		180373
Cargo total		77208
Zero Fuel Weight	**(Max 288000)**	257581
Ramp weight		327581
Taxi Fuel		1100
Take Off Fuel		68900
Take Off Weight	**(Op. Max. 351174)**	326481
Trip fuel		31174
Landing Weight	**(Max. 320000)**	295307

According to the latest aircraft weight and balance record, the aircraft was within the operational envelope and maximum weight allowed for takeoff as specified in the flight manual.

1.7 Meteorological information

METAR MPTO 232100Z 25015KT 9000 SCT018 33/22/Q1009 NOSIG

METAR report for Tocumen International Airport at 4:00 p.m.

Wind from 250 degrees at 15 knots, **visibility** 9,000 meters, **scattered clouds** at 1,800 feet, **temperature** 33°C, **dew point** 22°C, **altimeter** 1009 hectopascals.

Forecast trend: no significant changes expected over the next 2 hours.

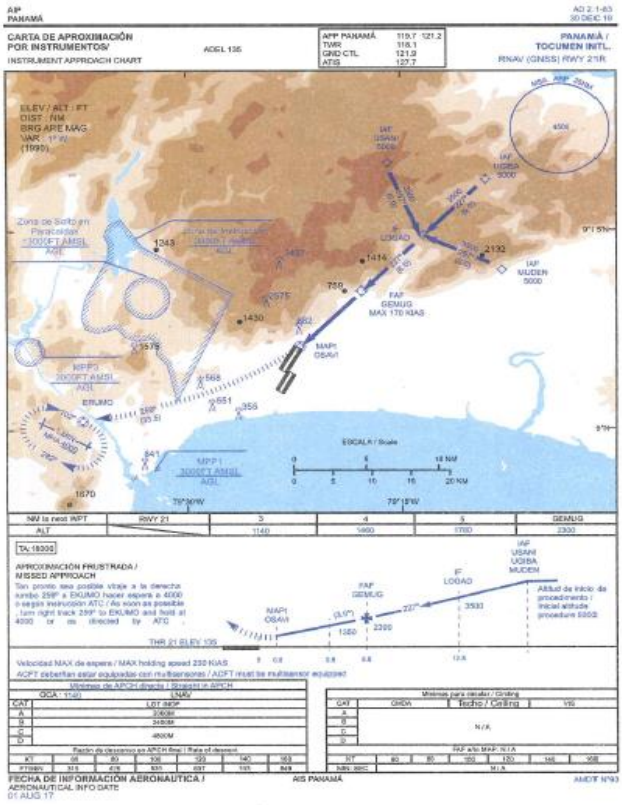
At the time of landing, the wind conditions reported by the control tower were 270/14, which gives a headwind component of 07 knots and a right crosswind component of 12 knots.

1.8 Aids to navigation

All airport approach aids were operating normally at the time of the accident.

Signals: 21R threshold, cross strip, centerline, sighting point, touchdown point, lateral strip, runway designator.

Lighting: 21R approach lights, threshold, offset threshold, runway edge, runway end, and PAPI system.



Picture No. 6 - Approach Chart for Tocumen International Airport MPTO.

1.9 Communications

Communications between the crew and the various air traffic control units were carried out without incident. On route, approach (APP) TWR, and ground control at Tocumen International Airport.

Communications were conducted in English, and there were no interferences or reception and transmission problems in either direction.

1.9.1 Transcription of the Cockpit Voice Recorder (CVR)

The following is a detailed account of the communications between the crew and tower control and between the crew related to the event.

The communications review showed that the crew used the checklist according to the AFM. Also, below 10,000 feet, there were informal conversations among the crew about general topics not related to flight operations and management.

Below is an extract from the operational communications related to the final approach until the aircraft's tail touched the runway, in which it was observed that the crew received an update on wind conditions, radio altimeter callouts, and audible alert of the Ground Proximity Warning System (GPWS) “Sink Rate” alarms

Time	Source of transmission	Communications
	APP to ABX 901	ABX 901 pass to tower 18.1
	ABX 901 to APP	18.1 ABX 901 Heavy
	FO	AGH! Big birds.
	PIC	Oh *#$*!
	Call out	One thousand (1000).
	ABX 901 to TWR	Tower ABX 901 visual 21R.
	TWR to ABX 901	ABX 901 it´s clear to land runway 21R, wind 270 14 knots is the 210 right.
	ABX 901 to TWR	Clear to land 21r ABX 901 Heavy
	PIC	Clear to land.
	FO	Roger
	FO	Birds at the right.
	Call Out	One hundred (100)
	Call Out	Fifty (50)
	Call Out	Sink Rate
	Call Out	Sink Rate
16:15:32	**Cabin Ambient Sound**	Tail Strike

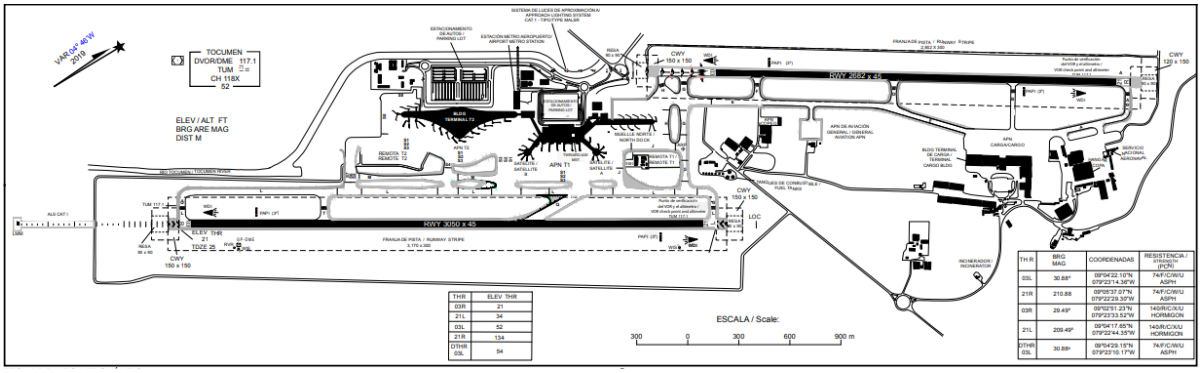
After the crash, there were communications between the crew related to the event, analyzing what had happened, in addition to operational communications with the surface frequency.

1.10 Aerodrome information

Tocumen International Airport S.A. Located 21 kilometers northeast of Panama City, in the district of Tocumen, it is used for regular and non-regular international passenger air transport, operating 24 hours a day, with an elevation of 134 FT/33°C, permitted traffic type (IFR-VFR), category 9 firefighting services, Runway 21R at Tocumen International Airport S.A. is 2,682 meters long x 45 meters wide, with an asphalt surface and a slope of 0.92%. It is located at coordinate’s 09°05.37' 07“N & 079°22'29.30” W.

Signals: 21R threshold, crossbar, centerline, visual reference point, touchdown zone, sideline, runway designator.

RWY	TORA (M)	TODA (M)	ASDA (M)	LDA (M)
03L	2,682	2,832	2,682	2,431
21R	2,682	2,802	2,682	2,682
03R	3,050	3,200	3,050	3,050
21L	3,050	3,200	3,050	3,050



Picture No. 7 – Airport map.

1.11 Flight recorders

The aircraft was equipped with both a flight data recorder (FDR) and a cockpit voice recorder (CVR), in accordance with current regulations for this type of aircraft and operation.

Both recorders were removed from the aircraft: FDR, Model FA2100, PNR 2100-4043-00, S/N 000001164, CVR Model FA2100, PNR 2100-1020-00, S/N 000421571.

The reading and transcription were carried out at the facilities of the National Transportation Safety Board (NTSB) of the United States of America.

1.12 Wreckage and impact information

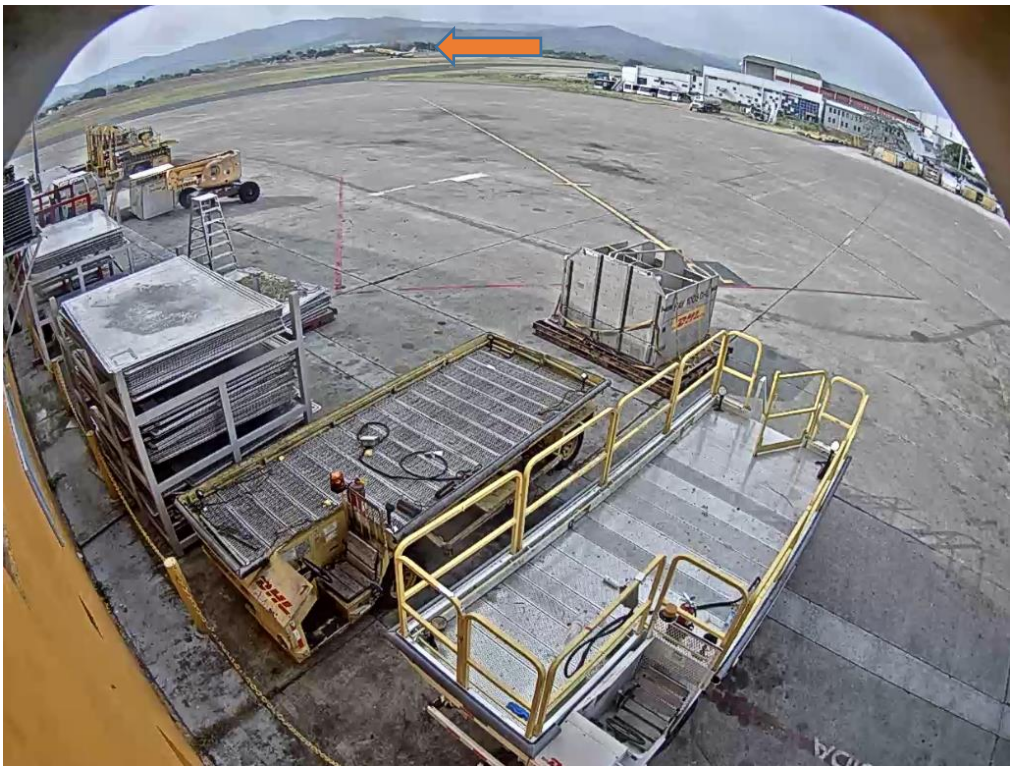
During landing, the rear lower part of the fuselage made contact with the runway approximately 125 meters from the 21R runway threshold, leaving a 1-meter mark. As a result of the impact, the tail skid detached from the aircraft and remained on the runway.



Picture No. 8 – Findings from field research

After the flight crew realized they had suffered a tail strike, they headed to the DHL ramp. As part of the maintenance support provided to the airline by Taller a National Aeronautical Workshop, GIRAG Panamá, S.A., an external visual inspection of the aircraft was carried out upon arrival at the position. During the inspection, obvious external structural deformations were observed in the tail section of the aircraft. The crew did not report the incident to the tower.

The crew of another aircraft that took off after the incident alerted the airport operations department to the presence of aircraft debris on the runway, which was recovered afterwards.







Picture No. 9, 10, and 11 - Sequence of events in the initial contact.

1.13 Medical and pathological information

The crew had valid medical certificates applicable to the type of operation.

The toxicological analysis performed did not reveal the presence of psychoactive substances in the crew.

1.14 Fire

None.

1.15 Survival aspects

The crew suffered no injuries.

1.16 Test and research

Investigators were notified two days after the incident, the aircraft was located, and evidence collection began, including marks left on the runway, documentation, and damage to the aircraft.

During the inspection of the aircraft, damage to the lower rear part of the fuselage caused by the impact with the runway was observed. Preliminary observation reports indicate that the tail of the aircraft struck the runway a few seconds before the main landing gear made contact with the runway (touchdown).

It was observed that the aircraft fuselage, both in the structural coating of the rear ventral area and in the tail skid, showed signs of friction, detachment of the fairing, and deformation as a result of the impact of the tail with the runway surface.

The aircraft maintenance technician who inspected the aircraft upon its arrival at the DHL hangar was interviewed. He confirmed and reported the damage found to the crew.

The National Transportation Safety Board (NTSB) of the United States of America interviewed the crew.

1.16.1 Highlights from the crew interview

According to the captain, he was familiar with operations at Tocumen Airport; however, this was the first time he had approached and landed on runway 21R, as was the case for the first officer.

Additionally, they noted that the flight proceeded without incident and upon arrival in Panama City; the approach was planned for runway 03 L. According to the captain, they were 5,000 ft. above their planned descent profile when they were informed of the weather conditions and the change of runway for landing to 21R.

They performed the normal procedures for the RNAV approach to runway 21R.

They continued the approach looking for the runway, and at UGIBA, they began to descend 3 miles from GEMUC and proceeded to configure the aircraft for landing. During the approach, already level at GEMUG at 2300 ft., they observed birds to the right of the flight path. They then disengaged the autopilot and began the final approach and descent from the authorized altitude. During this phase of the approach, they again observed birds near the aircraft.

According to the first officer's account, “As we were about to touch down, the descent speed alarm sounded. It sounded twice, and then he heard (Sink Rate) and felt a hard landing, followed by a message on the EICAS TAILSKID.”

Regarding the final approach to runway 21R and the landing maneuver, the captain "indicated that they had a crosswind from the right, advanced the aircraft to about 100 feet, and then used the ailerons and rudder to straighten it out, but he could not specify whether it was before or after the 50-foot radio altimeter callout that the EGPWS gave the audible Sink Rate signal. This situation surprised him, and he began to apply power at the same time that the aircraft hit the ground."

The captain also mentioned that the downward slope of the runway, from the approach end of 21R to the exit end, might have had an influence.

In turn, the first officer stated in the interview that he was originally scheduled to return to CVG and then from CVG to JFK, but due to delays caused by weather conditions, he was rescheduled for the Panama flight who served as PM.

1.16.2 Downloading flight recorders

The CVR and FDR data were downloaded, read, and transcribed at the facilities of the National Transportation Safety Board (NTSB) in the United States of America.

The aircraft manufacturer Boeing, through the NTSB, provided a technical report based on the analysis of the flight data recorder (FDR) corresponding to this event.

1.16.3 Approved documents from the operator ABX AIR

The operator was required to provide all documentation relating to the aircraft, including the B-767 Aircraft Operations Manual Volume 1 (AOM), the Flight Operations Manual (FOM) prepared by the company itself, and the Flight Training Manual (FTM).

Training records, crew flight hour logs, and the aircraft weight and balance manifest were also requested.

1.16.4 Tocumen Control Tower Report

21:16 UTC Arrival ABX901 RNAV RWY 21R
21:45 UTC OPS (FN) indicates by telephone that RWY 21R needs to be checked because DHL dispatch reported that aircraft N372CM suffered a tail strike on arrival.
22:05 UTC FN reports runway clear of FOD and operational.
According to the TWR's perspective, the ACFT had a normal landing. However, upon arriving at the cargo platform and after an inspection by DHL ground personnel, they observed that the tail had struck the runway. Apparently, the ABX captain was unaware of the incident, as he did not report it to the TWR at any time. Therefore, operations continued as normal.

1.16.5 Information in ABX company manuals

Information related to when a tail strike may occur, sterile cockpit, stabilized and unsterilized approaches, and criteria for discontinuing an approach (Go AROUND), strike, was extracted from the AFM and AOM operator manuals.

B-767 Aircraft Operating Manual Volume 1 (AOM)

D. Visual aim points versus gear touchdown point differences increase as glide path angle decreases as in a flat approach. For a particular visual approach, the difference between gear path and eye level path in the 767 must be accounted for by the pilot.

14.32.2 Threshold Height

A. Threshold Height is a function of glide path angle and landing gear touchdown target. Threshold height for main gear and pilot eye level is shown in the Two Bar/Three Bar VASI Landing Geometry tables as shown in AOM Chapter (14.35) Figures 14-13 and 14-14, Landing Flare Profile. Special attention must be given to establishing a final approach that will assure safe threshold clearance and gear touchdown at least 1,000 feet down the runway. If automatic callouts are not available, the radio altimeter should be used to assist the pilot in judging terrain clearance, threshold height, and flare initiation height.

14.33 Tail Strike Avoidance/Awareness

A. There are many factors that may cause a tail strike. Tail strikes are possible on either the takeoff or landing phases but historically more tail strikes occur during the landing phase and after main gear touchdown. Flight Crews may have no indication that a tail strike has taken place during the actual tail strike. Tower observation and/or post flight inspection may be the only indication to the Flight Crew of a tail strike. Flight Crews need to be aware of these associated conditions that increase the possibility of a tail strike and guard against these conditions. Many of the below bulleted items leave little room for error when you consider their cumulative effect.

1. V SPEEDS CORRECT FOR WEIGHT: Ensure ZFW is cross checked and entered correctly into FMC. *Airspeed control is **critical** for both takeoff and landing*. Make sure you enter the correct ZFW into the FMC so you have accurate V speed data for the thrust used. Calculating a lighter than actual takeoff weight could result in a slower Vr that contributes to dragging the tail on takeoff. Flying slow on the approach can create a higher than normal pitch attitude that will make over-flaring the aircraft more likely on landing. If you enter your projected landing gross weight into the FMC Approach Ref page early in the flight to calculate Vref, ask the other pilot to confirm your weight selection to make sure it is accurate. Be aware of your takeoff and approach speeds and when setting airspeed bugs, do a "reasonableness check."

2. BE ON SPEED: Fly Vref + 5 kts (or appropriate wind additive) until the beginning of the flare.

3. ATTITUDE AWARENESS: Being 5 knots slow on the approach adds 1 degree of nose up pitch attitude. A forward CG will increase your pitch attitude, be cautious about adding additional pitch in the landing flare. It

   will take very little control column force to over flare when already in a higher than standard pitch attitude.

4. FLY A STABLE APPROACH: Boeing has found that most tail strikes occur after unstable approaches or approaches flown at slower than normal airspeeds. If you are not stabilized by 500 ft. on profile at Vref+5 kts.

   (or appropriate speed additive) a go around is required. Excess energy over the threshold makes touchdown difficult, increases floating and increases the odds of a tail strike.

5. OVER FLARING: Do Not over flare to arrest a fast descent rate. Do not attempt to hold the airplane off the runway in the flare or continue the flare after touchdown. DO NOT allow pitch attitude to increase after touchdown. Deployment of ground spoilers can cause the pitch to increase up 1 to 1.5 degrees. Some tail strikes have occurred after spoilers deployed. Again, DO NOT allow the pitch to increase after touchdown.

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Standard procedures

During Approach

a. Monitor radio altimeters for anomalies.

b. Monitor for anomalous TCAS/RA.

c. Monitor for anomalous GPWS alerts.

d. For ILS approaches, disconnect the autopilot and autothrottle, and place both flight director switches to OFF prior to glideslope intercept.

e. Non-precision approaches can be flown using LNAV/VNAV with flight directors and autopilot to published minimums.

f. At DA(H), MDA(H), or the missed approach point.

1. If suitable visual reference is established, disconnect the autopilot and auto- throttle and continue for a normal manual landing.

2. If a go-around is needed, do the go-around and the missed approach procedure either in manual or automatic flight.

8. **During Landing**

a. Radio altitude-based altitude aural callouts during approach may not be available or erroneous.

b. **N290CM, N390CM, N391CM**

1. Manual deployment of the speedbrakes may be needed.

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During Go-Around and Missed Approach

a. Go-around mode may not be available.

b. Monitor thrust and verify that thrust increases.

c. If flight director is ON, cycle to OFF, then ON, as needed.

d. If flight director is OFF, turn ON as needed.

e. Monitor pitch mode engagement.

f. Monitor roll mode engagement.

g. Autopilot may not engage.

h. Altitude capture may not occur, altitude alerts are available.

E. **If Radio Altimeter Anomalies are Experienced**

Operators and pilots who experience radio altimeter anomalies should notify air traffic control, as soon as practical. Post flight, follow established procedures or policies to document the radio altimeter anomaly so that the radio altimeters can be checked for proper operation. Pilots are encouraged to submit detailed reports of radio altimeter disruptions or interference events, as soon as practical, using the Radio Altimeter Anomaly Reporting Form available on the FAA website at https://www.faa.gov/air_traffic/nas/ RADALT_reports/.

F. **Additional References**

FAA Safety Alert for Operators SAFO 21007

FAA Special Airworthiness Information Bulletin SAIB AIR-21-18R1

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15.44.2 Mistrimmed Stabilizer

A. This usually results from using erroneous takeoff data, e.g., the wrong weights, or an incorrect center of gravity (CG). In addition, sometimes the information presented to the flight crew is accurate, but is entered incorrectly either in the flight management system (FMS) or set incorrectly on the stabilizer. The flight crew can prevent this type of error and correct the condition by challenging the reasonableness of the load sheet numbers. Comparing the load sheet numbers against past experience in the aircraft can assist in approximating numbers that are reasonable.

15.44.3 Rotation at Improper Speed

A. This situation can result in a tail strike and is usually caused by early rotation due to some unusual situation, or rotation at too low an airspeed for the weight and/or flap setting.

15.44.4 Excessive Rotation Rate

A. Flight crews operating an airplane model that is new to them, especially when transitioning from an airplane with unpowered flight controls to one with hydraulic assistance, are most vulnerable to using excessive rotation rate. The amount of control input required to achieve the proper rotation rate varies from one model to another. When transitioning to a new model, flight crews may not consciously realize that it will not respond to pitch input in exactly the same way as their previous model.

15.44.5 Improper Use Of The Flight Director

A. The flight director is designed to provide accurate pitch guidance only after the airplane is airborne. With the proper rotation rate, the airplane reaches 35 feet with the desired pitch attitude of about 15 degrees. However, an aggressive rotation into the pitch bar at takeoff is not appropriate and may rotate the tail onto the ground.

15.44.6 Landing Risk Factors

A. A tail strike on landing tends to cause more serious damage than the same event during takeoff and is more expensive and time consuming to repair. In the worst case, the tail can strike the runway before the landing gear touches down, thus absorbing large amounts of energy for which it is not designed. The aft pressure bulkhead is often damaged as a result.

B. Any one of these landing risk factors may precede a tail strike.

15.44.7 Unstabilized Approach

A. An unstabilized approach appears in virtually every landing tail strike event. When an airplane turns on to final approach with excessive airspeed, excessive altitude, or both, the situation may not be under the control of the flight crew. The most common cause of this scenario is the sequencing of traffic in the terminal area as determined by air traffic control.

B. An unstabilized approach is the biggest single cause of tail strike. Flight crews should attempt to reach all the approach variables - on centerline, on approach path, on speed, and in the final landing configuration - by the time the airplane descends through 1,000 feet above ground level (AGL). This is not always possible. Under normal conditions, if the airplane descends through 1,000 feet AGL (IMC), or 500 feet AGL (VMC), with these approach variables not stabilized, a go-around should be considered.

C. Flight recorder data show that flight crews who continue with an unstabilized condition below 500 feet will never stabilize the approach. When the airplane arrives in the flare, it invariably has either excessive or insufficient airspeed. The result is a tendency toward large power and pitch corrections

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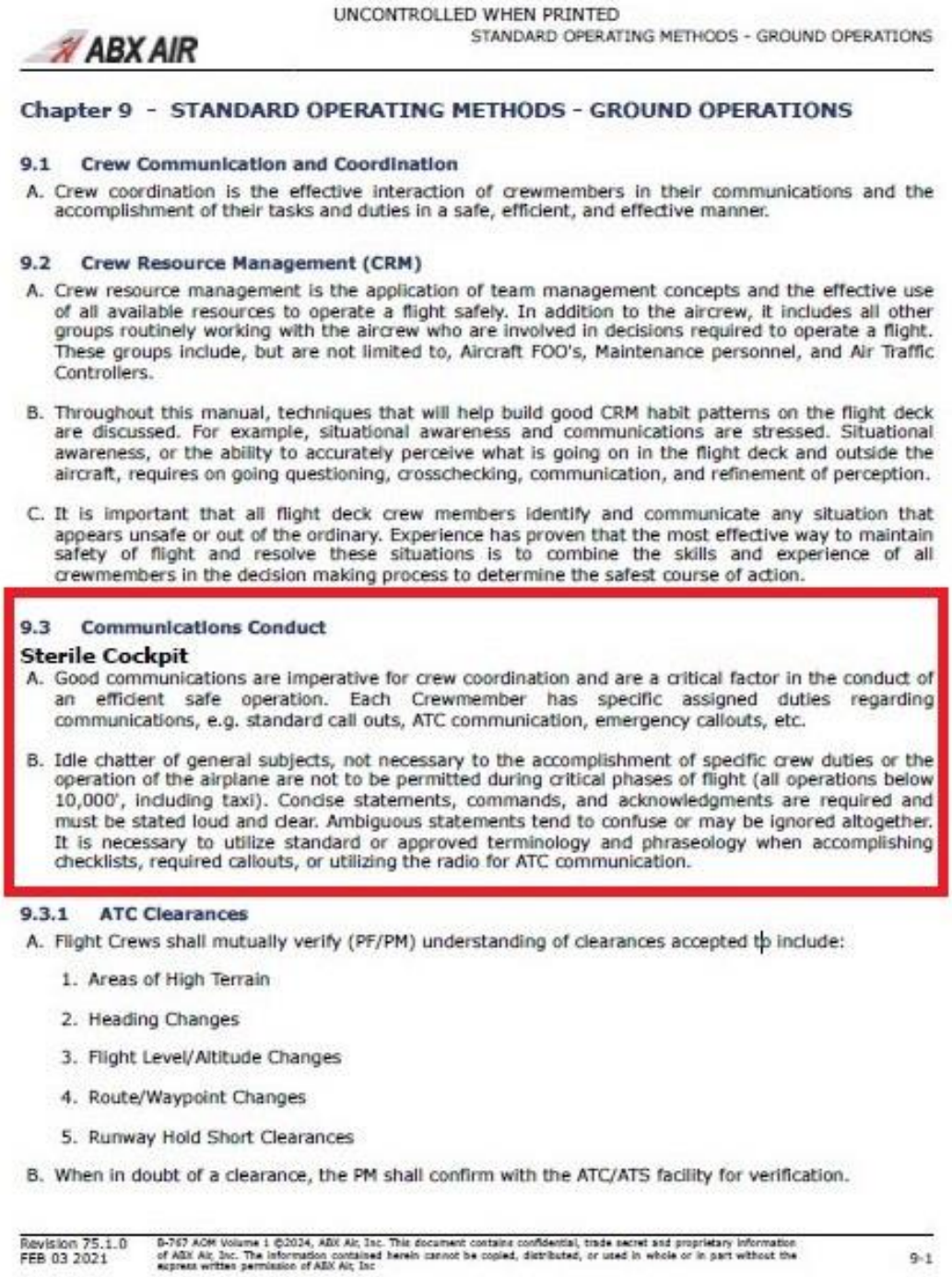
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STANDARD OPERATING METHODS - EMERGENCY PROCEDURES

in the flare, often culminating in a vigorous pitch change at touchdown resulting in tail strike shortly thereafter. If the pitch is increased rapidly when touchdown occurs as ground spoilers deploy, the spoilers add additional nose up pitch force, reducing elevator authority, which increases the possibility of tail strike. Conversely, if the airplane is slow, increasing the pitch in the flare does not effectively reduce the sink rate and in some cases, may increase it.

D. A firm touchdown on the main gear is often preferable to a soft touchdown with the nose rising rapidly. In this case, the momentary addition of power may aid in preventing the tail strike. In addition unstabilized approaches can result in landing long or runway over run.

ABX defines policies on conduct in communications and sterile cabins in Chapter 9 of its FOM.

Informal conversations on general topics that are not necessary for the performance of specific crew tasks or for the operation of the aircraft are not permitted during critical phases of flight (all operations below 10,000 feet, including taxiing).



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STANDARD OPERATING METHODS - GROUND OPERATIONS

Chapter 9 - STANDARD OPERATING METHODS - GROUND OPERATIONS

9.1 Crew Communication and Coordination

A. Crew coordination is the effective interaction of crewmembers in their communications and the accomplishment of their tasks and duties in a safe, efficient, and effective manner.

9.2 Crew Resource Management (CRM)

A. Crew resource management is the application of team management concepts and the effective use of all available resources to operate a flight safely. In addition to the aircrew, it includes all other groups routinely working with the aircrew who are involved in decisions required to operate a flight. These groups include, but are not limited to, Aircraft FOO's, Maintenance personnel, and Air Traffic Controllers.

B. Throughout this manual, techniques that will help build good CRM habit patterns on the flight deck are discussed. For example, situational awareness and communications are stressed. Situational awareness, or the ability to accurately perceive what is going on in the flight deck and outside the aircraft, requires on going questioning, crosschecking, communication, and refinement of perception.

C. It is important that all flight deck crew members identify and communicate any situation that appears unsafe or out of the ordinary. Experience has proven that the most effective way to maintain safety of flight and resolve these situations is to combine the skills and experience of all crewmembers in the decision making process to determine the safest course of action.

9.3 Communications Conduct

Sterile Cockpit

A. Good communications are imperative for crew coordination and are a critical factor in the conduct of an efficient safe operation. Each Crewmember has specific assigned duties regarding communications, e.g. standard call outs, ATC communication, emergency callouts, etc.

B. Idle chatter of general subjects, not necessary to the accomplishment of specific crew duties or the operation of the airplane are not to be permitted during critical phases of flight (all operations below 10,000', including taxi). Concise statements, commands, and acknowledgments are required and must be stated loud and clear. Ambiguous statements tend to confuse or may be ignored altogether. It is necessary to utilize standard or approved terminology and phraseology when accomplishing checklists, required callouts, or utilizing the radio for ATC communication.

9.3.1 ATC Clearances

A. Flight Crews shall mutually verify (PF/PM) understanding of clearances accepted to include:

1. Areas of High Terrain
2. Heading Changes
3. Flight Level/Altitude Changes
4. Route/Waypoint Changes
5. Runway Hold Short Clearances

B. When in doubt of a clearance, the PM shall confirm with the ATC/ATS facility for verification.

Revision 75.1.0
FEB 03 2021

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9-1

The company's flight operations manual (FOM) establishes the conditions for an approach to be considered stabilized in Chapter VIII, 8.5 Stabilized Approach.

Flight Operations Manual (FOM) - ABX

8.5 Stabilized Approach

A. A stabilized approach is defined as the aircraft being in the landing configuration, airspeed steady at the target speed, descent rate steady at the appropriate rate, power set to maintain the airspeed and descent rate, and the aircraft's path leading to the touchdown zone aligned with the center line of the runway.

1. This chapter applies from the, "1000' above minimums (or touchdown)" call to the flare.
2. An unstable approach will often lead to a hard landing, a tail strike, an engine strike, an excessive landing run, hot brakes or an over-run.

WARNING

A Go-Around is always an option. A Go-Around is always considered a mark of good airmanship and will never be questioned.

B. Do not continue the approach unless by the "1000' above" call.

1. All briefings for the approach are complete.
2. The airplane is in the landing configuration with the gear down and the final flaps set.
3. The Landing Checklist is complete.

C. Below the "1000' above" call.

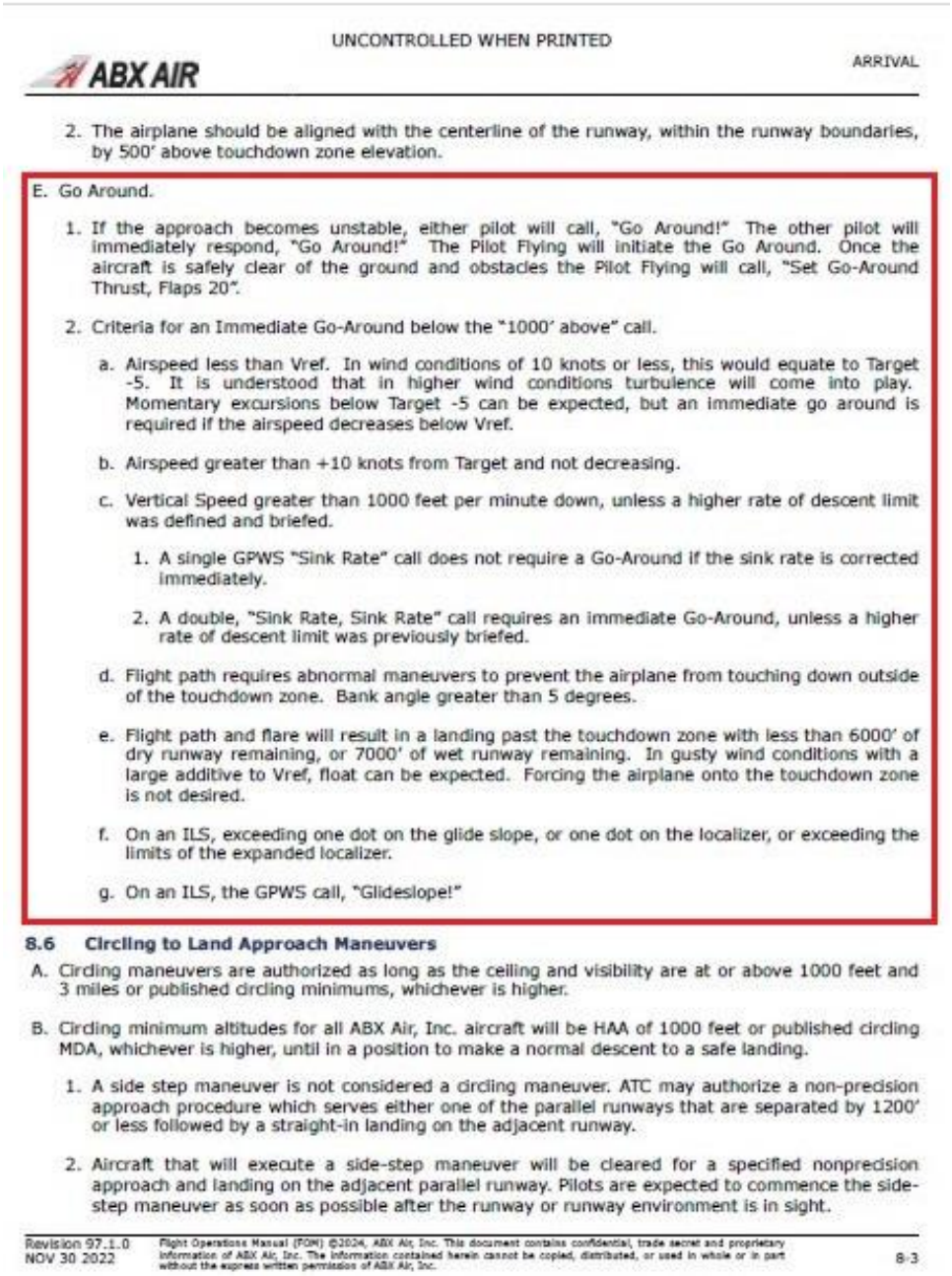
1. Airspeed is within -5 knots to +10 knots of Target and stable.
2. Vertical Speed appropriate and stable. This is normally 5x Ground Speed for a 3 degree glide slope, +/- 200 feet per minute for corrections.
   a. For a ground speed of 130 knots this would be 650 feet per minute, +/- 200 feet per minute for corrections.
   b. 1000 feet per minute of descent will be considered a limit unless previously briefed.
   c. At a high-altitude airport with a 10 knot tailwind, a ground speed of 170 knots would result in an appropriate descent rate of 850 feet per minute, +/- 200 feet per minute for glide slope corrections.
3. Power spooled up with only small adjustments.
4. The flight path aligned with the centerline of the runway, within the runway boundaries, and leading to the touchdown zone.
5. On an ILS. Within one dot of the glideslope and within one dot of the localizer, or within the expanded localizer.

D. Visual Approaches.

1. The airspeed may be +30 of Target below 1000' above the touchdown zone elevation, decreasing to be at -5 knots to +10 knots of Target at 500' above touchdown zone elevation. The thrust levers should not be at idle.

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The company's FOM, in point E, establishes procedures and criteria for performing a go-around.



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ARRIVAL

2. The airplane should be aligned with the centerline of the runway, within the runway boundaries, by 500' above touchdown zone elevation.

E. Go Around.

1. If the approach becomes unstable, either pilot will call, "Go Around!" The other pilot will immediately respond, "Go Around!" The Pilot Flying will initiate the Go Around. Once the aircraft is safely clear of the ground and obstacles the Pilot Flying will call, "Set Go-Around Thrust, Flaps 20".

2. Criteria for an Immediate Go-Around below the "1000' above" call.

a. Airspeed less than Vref. In wind conditions of 10 knots or less, this would equate to Target -5. It is understood that in higher wind conditions turbulence will come into play. Momentary excursions below Target -5 can be expected, but an immediate go around is required if the airspeed decreases below Vref.

b. Airspeed greater than +10 knots from Target and not decreasing.

c. Vertical Speed greater than 1000 feet per minute down, unless a higher rate of descent limit was defined and briefed.

1. A single GPWS "Sink Rate" call does not require a Go-Around if the sink rate is corrected immediately.

2. A double, "Sink Rate, Sink Rate" call requires an immediate Go-Around, unless a higher rate of descent limit was previously briefed.

d. Flight path requires abnormal maneuvers to prevent the airplane from touching down outside of the touchdown zone. Bank angle greater than 5 degrees.

e. Flight path and flare will result in a landing past the touchdown zone with less than 6000' of dry runway remaining, or 7000' of wet runway remaining. In gusty wind conditions with a large additive to Vref, float can be expected. Forcing the airplane onto the touchdown zone is not desired.

f. On an ILS, exceeding one dot on the glide slope, or one dot on the localizer, or exceeding the limits of the expanded localizer.

g. On an ILS, the GPWS call, "Glideslope!"

8.6 Circling to Land Approach Maneuvers

A. Circling maneuvers are authorized as long as the ceiling and visibility are at or above 1000 feet and 3 miles or published circling minimums, whichever is higher.

B. Circling minimum altitudes for all ABX Air, Inc. aircraft will be HAA of 1000 feet or published circling MDA, whichever is higher, until in a position to make a normal descent to a safe landing.

1. A side step maneuver is not considered a circling maneuver. ATC may authorize a non-precision approach procedure which serves either one of the parallel runways that are separated by 1200' or less followed by a straight-in landing on the adjacent runway.

2. Aircraft that will execute a side-step maneuver will be cleared for a specified nonprecision approach and landing on the adjacent parallel runway. Pilots are expected to commence the side-step maneuver as soon as possible after the runway or runway environment is in sight.

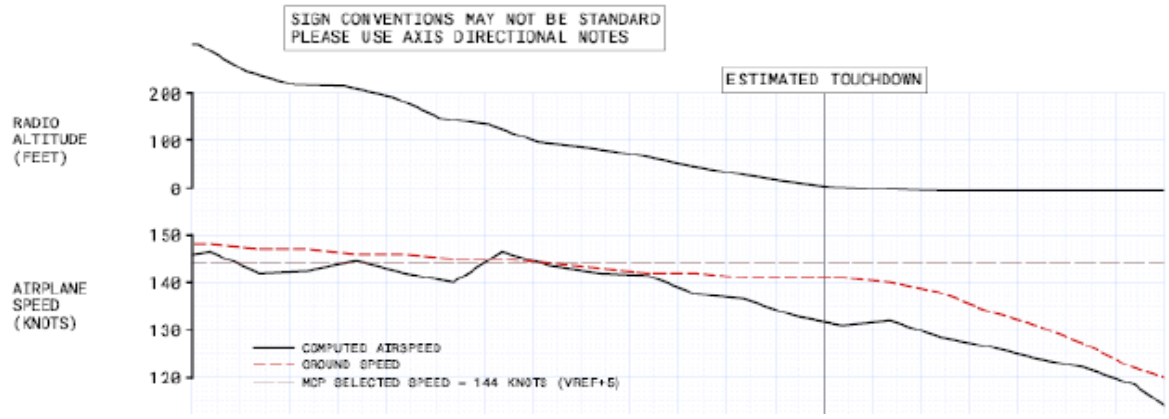
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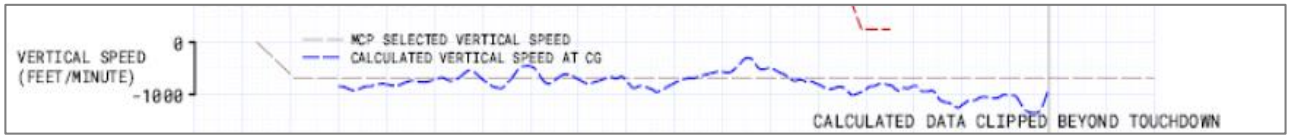
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1.16.6 Flight data recorder information (FDR)

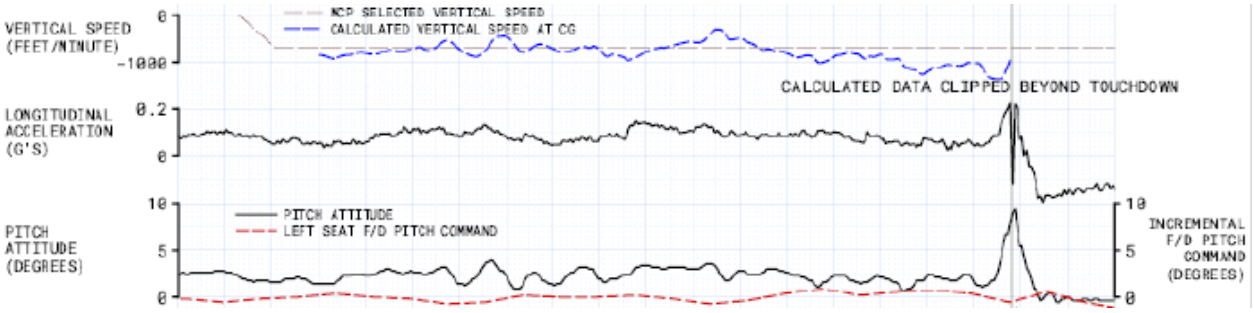
The following information is obtained from the report prepared by the manufacturer based on data read from the flight recorder of the aircraft involved in the accident.

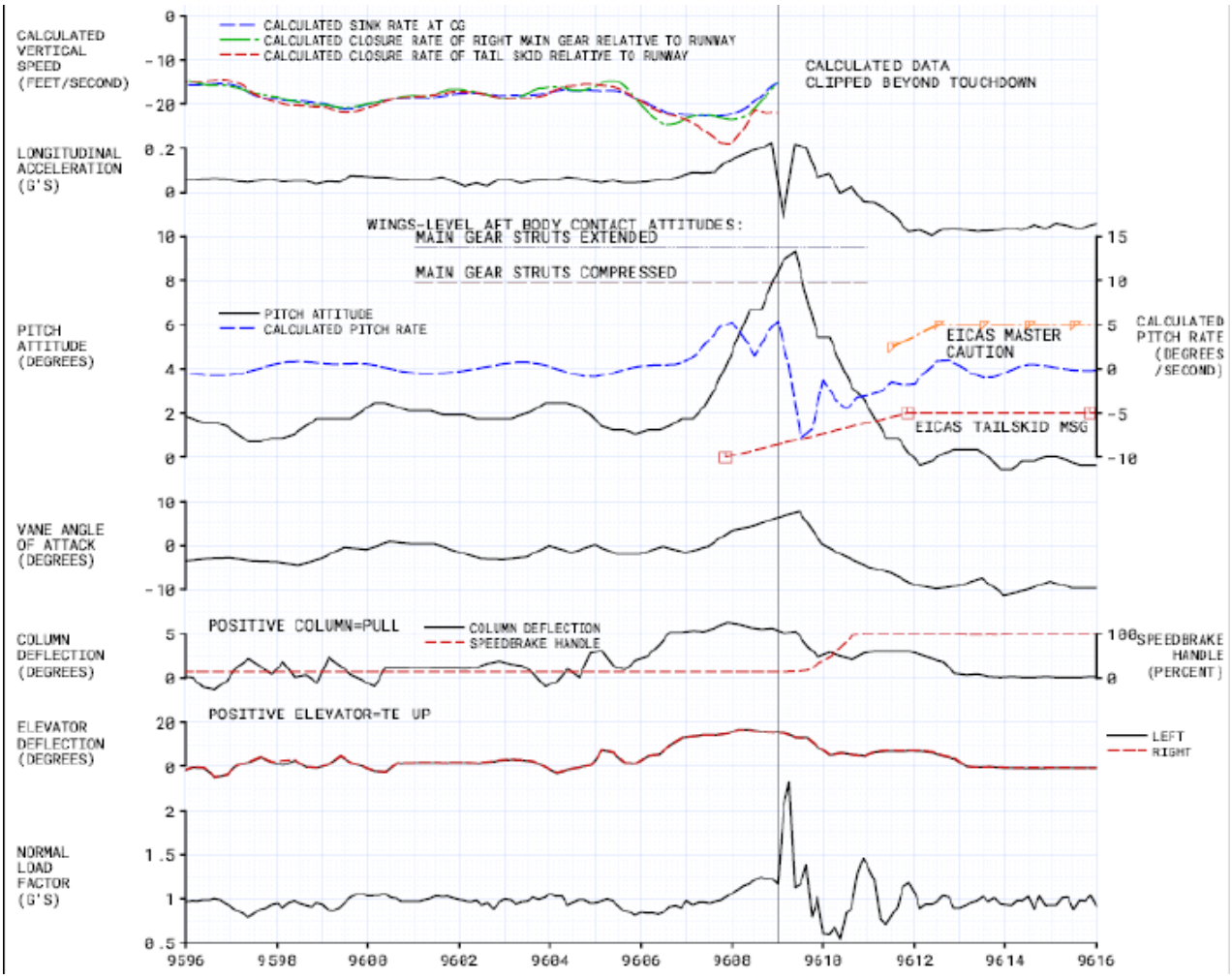


The FDR data show that the computed airspeed reduced to 139 knots (5 knots below the Mode Control Panel (MCP) selected speed) near a radio altitude of 50 feet, and continued to reduce further until initial touchdown around 132 knots (12 knots below the MCP selected speed). An increased tailwind between the start of flare and touchdown contributed to the reduction in computed airspeed.

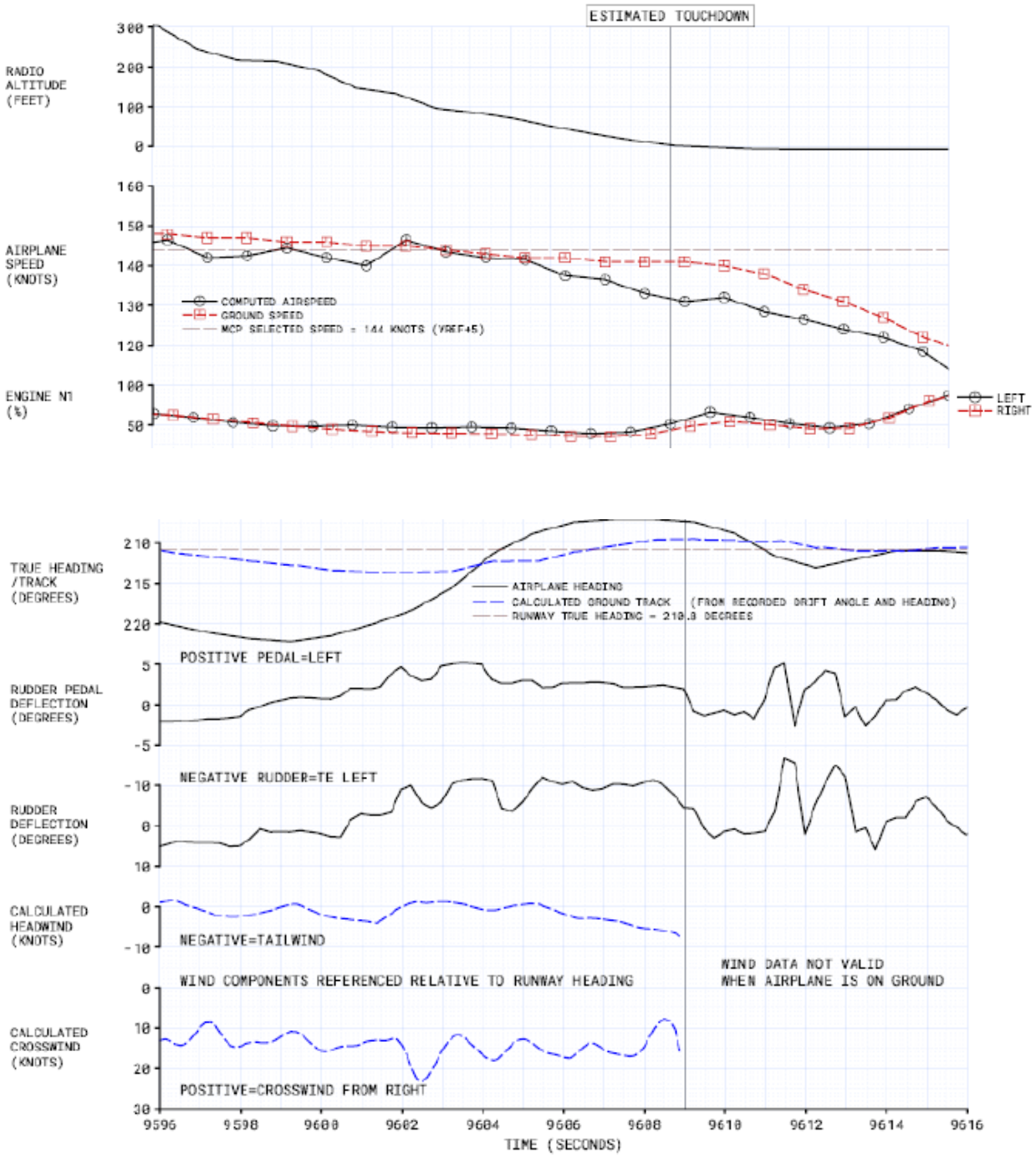


Calculated sink rate exceeded 1000 fpm for a duration of approximately 11 seconds (between times 9598 and 9609 seconds), below approximately radio altitude 250 feet and initial touchdown, and reached up to 1400 fpm.





Observation of the FDR data shows that pitch attitude increased from near 2 degrees around start of flare to around 8.4 degrees at initial touchdown and the pitch attitude continued to increase to near 9.3 degrees shortly after touchdown while column deflection remained elevated near 5 degrees. The airplane over-rotated with a pitch attitude change of approximately 6.4 degrees between the estimated start of flare to initial touchdown, which significantly exceeded the Boeing Flight Crew Training Manual (FCTM) recommendation of a pitch attitude increase of approximately 2 to 3 degrees. The Power Lever Angles (PLAs) were advanced to well above idle shortly before touchdown, exceeding the FCTM recommendation to have throttle levers at idle approximately coincident with main gear touchdown. The increase in PLA and subsequent increase in engine N1 prior to touchdown increased the pitch attitude due to the under slung engines.

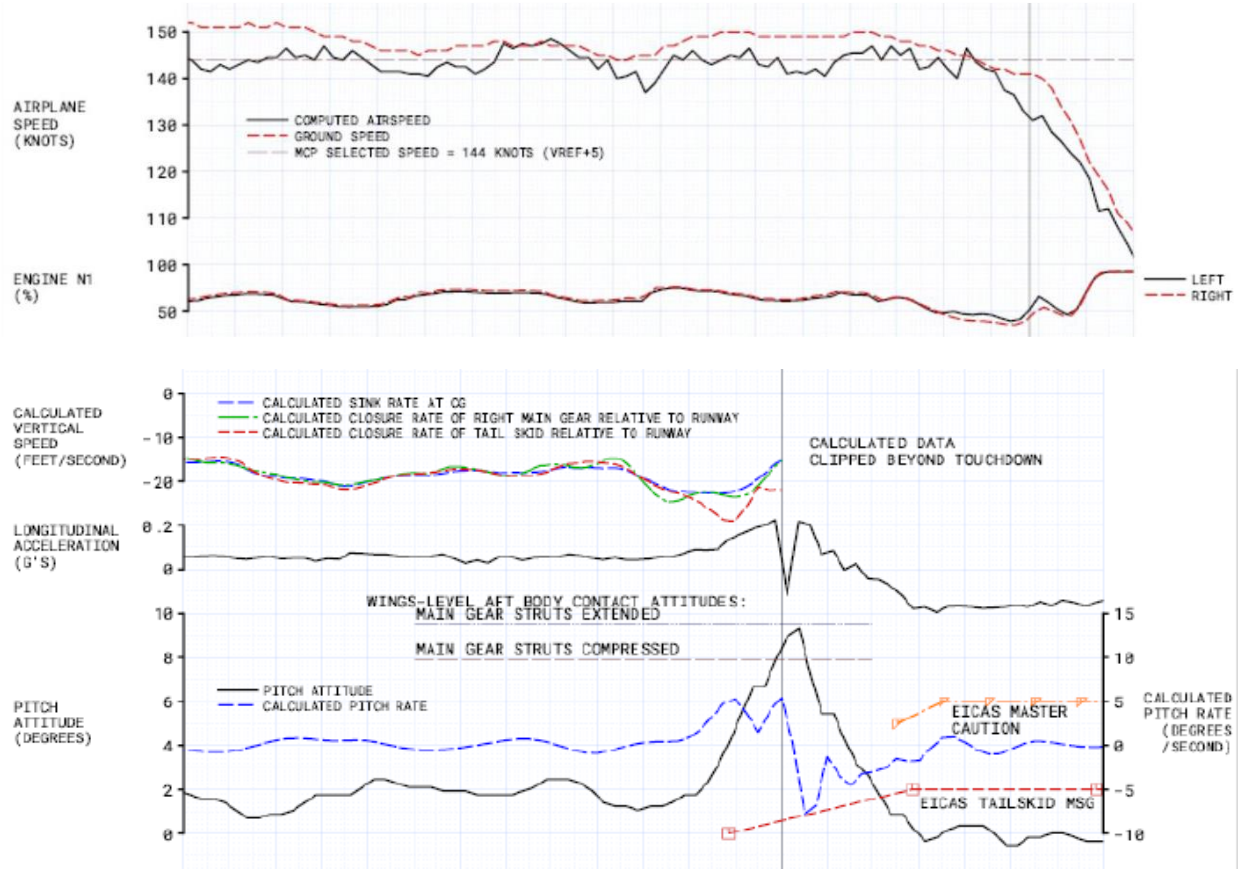


The FCTM contains the following recommendations under the Airspeed Control section:

If the autothrottle is disconnected, or is planned to be disconnected prior to landing, maintain reference speed plus any wind additive until approaching the flare. Minimum command speed setting is VREF + 5 knots. With proper flare technique and thrust management the 5 knot additive and some of the steady wind additive may be bled off

prior to touchdown. Plan to maintain gust correction until touchdown. Touchdown should occur at no less than VREF - 5 knots.

The data show that touchdown occurred near 132 knots, equivalent to VREF-7, which contributed to an increased pitch attitude and reduced aft body clearance with the runway an increased tailwind between the start of flare and initial touchdown contributed to a reduction in computed airspeed.



the ‘TAILSKID’ Engine Indication and Crew Alerting System (EICAS) message became displayed in the flight deck and remained active for the remainder of the data recording.

The 767 Quick Reference Handbook (QRH) Non-Normal Maneuvers Section Man. 1.4 “Ground Proximity GPWS Caution” includes the following information regarding GPWS alerts:

Accomplish the following maneuver for any of these aural alerts

• GLIDESLOPE

• SINK RATE

• TOO LOW FLAPS

……

Pilot Flying	Pilot Monitoring
Correct the flight path or the airplane configuration	

Note: *As installed, some repeat.

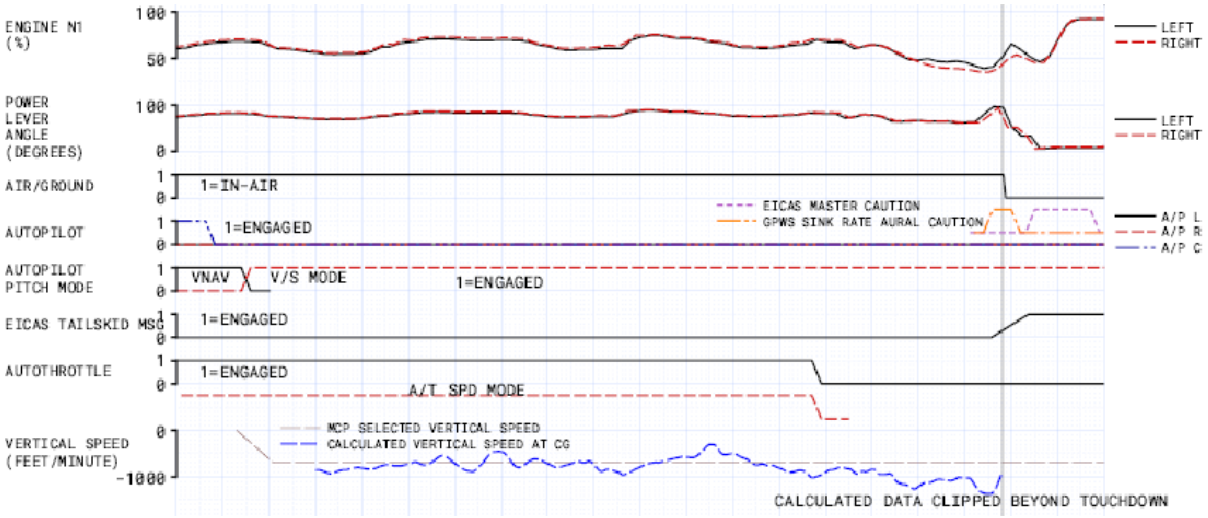
The data show that a GPWS “SINK RATE” aural caution would have annunciated in the flight deck prior to initial touchdown. Around the same time, the PLAs for the left and right engines were advanced by the flight crew, consistent with QRH guidance (and presumably a flight crew effort) to correct the flight path by attempting to reduce the sink rate.

The FCTM Chapter 1 Autopilot Flight Director System (AFDS) Guidelines includes the following information regarding use of the autothrottle:

Using the autothrottle

Autothrottle Use Autothrottle use is recommended during takeoff and climb in either automatic or manual flight. During all other phases of flight, autothrottle use is recommended only when the autopilot is engaged.

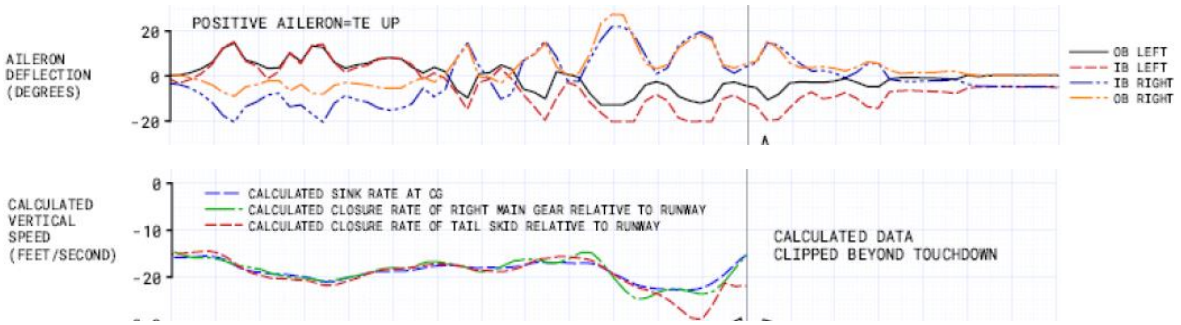
The FDR data show that the autothrottle remained engaged with the autopilot disengaged during the approach between radio altitudes of approximately 1110 feet and 400 feet (Figure 1). The autopilot was disengaged near a radio altitude of 1110 feet, and the autothrottle was disengaged near a radio altitude of 400 feet.



Based on the FCTM-recommended guidance, the autothrottle should have been disengaged by the flight crew coincident with disengaging the autopilot.

The following graph shows that the pilot in command made significant deviations on the longitudinal axis (control column) during the approach, which caused the spoilers on the

wing to activate. Similarly, an increase in the descent rate of more than 20 feet per second was verified, with a consequent loss of altitude prior to touchdown.



1.17 Organizational and management information

The company ABX, owner of the aircraft with registration number N372CM used for commercial cargo transport, with its main base at 145 Hunter Drive, Wilmington, Ohio 45177, USA.

Its aircraft portfolio focuses on wide-body cargo aircraft for cost-effective cargo transport, maximizing air transport capacity from payload.

It has 15 Boeing 767-300s and 8 Boeing 767-200 cargo aircraft in service.

1.18 Additional information

1.18.1 Background on tail strike globally

Global statistics and risks (2013–2022):

According to the IATA safety report (Global Aviation Data Management – GADM), tail strikes accounted for approximately 9% of all accidents recorded between 2013 and 2022.

79% of tail strikes occurred during the landing phase or final approach/go-around maneuvers, while the rest occurred during takeoff or climb.

The most common factors:

- Unstable approaches,
- Excessive energy on approach (long flares or bounces),
- Crosswinds,
- Strong wind gusts or turbulence, and floating on the runway.

Most of these accidents and incidents caused severe damage to the aircraft, resulting in significant repair costs and downtime.

1.19 Useful or effective investigation techniques

No special investigative techniques were required for the investigation. The investigation followed the techniques and methods recommended by ICAO Document 9756, Part III.

2. ANALYSIS

2.1 Flight operations

The aircraft crew held the appropriate licenses and ratings, with no observations.

For the flight, the captain was the pilot in command (PIC) and the first officer (FO) was the pilot monitoring (PM).

2.1.2 Approach to runway 21R

Concept of a stabilized approach

According to the operator's aircraft Operations Manual, a stabilized approach is defined as when the aircraft is in the landing configuration, with constant airspeed at the target speed, constant descent rate at the appropriate speed, power adjusted to maintain airspeed and descent rate, and the aircraft's path to the touchdown zone aligned with the runway centerline.

During the final approach made by aircraft N372CM, it was established based on data obtained from the FDR that the descent rate exceeded 1,000 feet per minute over a period of approximately 11 seconds and below the radio altimeter altitude of 250 feet and the initial contact point, reaching a maximum of up to 1,400 feet per minute. Also during this period, significant actions were recorded on the control column in the longitudinal axis (roll), probably in order to correct for crosswind. This caused the spoilers to activate, affecting the aircraft's lift and possibly contributing to the increase in descent rate and loss of altitude.

This descent rate during the final part of the approach resulted in an unstable approach according to the criteria established in FOM Chapter VIII, 8.5.

Similarly, the operator established different criteria that the crew must consider and recognize that they are on a destabilized approach and interrupt it and execute a go-around procedure, and perform a new approach procedure.

Faced with this destabilized final approach with a descent rate exceeding 1,000 feet per minute below 250 feet radio altimeter, which activated the audible Sink Rate alarm twice below the 50-foot callout, and from listening to the CVR, the crew did not consider interrupting the landing and performing the Go Around procedure, in discrepancy with the company's standard operating procedures.

On the other hand, it should be clarified, taking into account the statements of the crew and corroborated with the FDR data, the corrective actions taken by the crew to increase thrust and simultaneously activate the control lever, increasing the pitch angle prior to contact with the runway, indicate that they recognized the undesirable state of the aircraft; and that these actions were not sufficient to modify the descent trajectory and avoid abnormal contact with the runway.

2.2 Airworthiness

Based on the inspection of the aircraft, review of its maintenance history, and analysis of data extracted from the FDR, the investigation did not identify any problems with the systems or recent maintenance actions that could have contributed to the accident.

At the time of the accident, the aircraft had a valid airworthiness certificate.

2.3 Weight and balance

According to the analysis conducted by Flight Dispatch, the aircraft's weight and center of gravity were within the limits established in the aircraft's flight manual at the time of takeoff.

2.4 Aerodrome

There were no reports of abnormal operation of any ground navigation aids or any ground visual aids at the aerodrome at the time of the aircraft's approach and landing on runway 21R.

2.5 Meteorology

Based on FDR data using the heading of runway 21R at 210.8 degrees, the aircraft would have experienced a headwind of approximately 12 knots and a crosswind from the right of 9 knots, conditions that could have contributed to the accident.

2.6 Human factors

According to interviews with the flight crew, they had no personal problems of any kind that could have affected their performance. The crew did not report any medical issues.

With regard to the expected operational performance of the crew, this was probably affected by a series of incidents that the crew experienced during the flight and which culminated in an abnormal contact with the runway. The incidents with the potential to affect operational performance were: excessive delay in departure from the airport of departure, a change in the runway in use for landing 21 R, with which the pilot in command and first officer were unfamiliar, sighting of birds during the approach, a crosswind component of 9 kt. from the right, and a negative slope of the runway that may have influenced the pilot's depth perception when initiating the flare maneuver.

2.7 Recorders

The flight data recorder (FDR) was functioning and recording data. The download captured all the flight parameters necessary for the analysis of this event.

The cockpit voice recorder (CVR) was functioning and recording without any anomalies. It was used for the analysis of this accident.

3. CONCLUSIONS

- The aircraft had a valid Airworthiness Certificate and was kept in accordance with regulations.
- The flight crew had licenses and medical certificates in accordance with existing regulations.
- The activation of the spoilers caused by actions on the control column (ailerons) led to a decrease in lift, which could have contributed to the increase in descent rate and loss of altitude.
- The final approach was destabilized because the descent rate exceeded 1,000 feet per minute over a period of 11 seconds, below the 250-altimeter radio to the point of touchdown on the runway.
- The crew did not consider performing a go-around despite having two indications of deviation, such as a descent rate greater than 1,000 feet/minute and two sink rate alerts prior to contact with the runway.
- The corrective actions taken by the pilot in command on the flight controls and engines were not sufficient to prevent abnormal contact with the runway.
- The aircraft had abnormal contact with the runway when the tail skid hit the runway during landing.
- Touch down at an airspeed of no less than VREF5.
- Reduce the engine power setting to idle before touchdown.
- Wind conditions during landing may have contributed to abnormal contact with the runway.
- There was no coordination, and there was no evidence of participation by the monitoring pilot.
- The crew was unfamiliar with the approach and landing on runway 21R.
- Crew training met the standards set out in the company's training manual.
- The flight crew complied with their duty and rest periods.
- According to the CVR transcripts, there were informal conversations unrelated to flight operations below 10,000 feet.

3.1 Probable cause

During the landing maneuver of a commercial flight, the aircraft experienced abnormal contact with the runway caused by the impact of the lower part of the tail fuselage, which resulted in structural damage to the aircraft.

The accident was caused by:

1. Continue with the destabilized approach caused by a descent rate greater than 1000 feet per minute below 250 feet altimeter radius until initial touchdown.
2. Failure to perform the go-around procedure in the event of an unstable approach, in accordance with the standards established by the operator.
3. The corrective actions taken by the crew to increase thrust and simultaneously activate the control lever to increase the pitch angle were not effective in modifying the descent trajectory and preventing abnormal contact with the runway.

3.2. ECCAIRS standardized taxonomy based on ICAO ADREP

In the ECCAIRS taxonomy, it is classified as ARC (Abnormal Contact with Runway).

4. SAFETY RECOMMENDATIONS

4.1 To The Operator ABX AIR

Introduction.

With regard to crew training and education, based on the analysis, the following recommendations are made:

REC. 001 ACCID-N372CM-2024

Plan and initiate training for all pilots in order to reinforce the following concepts:

a) Criteria for stabilized and unstabilized approaches and go-around procedure when an unstabilized approach is identified.
b) Standardized procedures for unstable approaches and thrust recovery, including strict control of angles and throttle.
c) Monitoring of weather conditions such as crosswinds and gusts.
d) Recommendations and limitations on the use of autopilot simultaneously with auto throttle. (According to manual).
e) Specific training for the crew by model and practicing go-around and flare scenarios in a simulator.
f) Sterile cabin below 10,000 feet.

REC. 002 ACCID-N372CM-2024

Share the results of the investigation with flight crews.

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