SOUTH AFRICAN CIVIL AVIATION AUTHORITY

Section/division **Accident and Incident Investigations Division** Form Number: CA 12-12b

AIRCRAFT SERIOUS INCIDENT REPORT AND EXECUTIVE SUMMARY

			Reference:	**CA18/3/2/1392**	
Aircraft Registration	**ZS-ZWD**	**Date of Incident**	10 February 2022	**Time of Incident**	0417Z
Type of Aircraft	Boeing 737-800		**Type of Operation**	Commercial (Part 121)	
Pilot-in-command Licence Type	ATPL		**Age** 43	**Licence Valid**	Yes
Pilot-in-command Flying Experience	**Total Flying Hours**	12117		**Hours on Type**	7928
Last Point of Departure	Lanseria International Airport (FALA), Gauteng Province				
Next Point of Intended Landing	Cape Town International Airport (FACT), Western Cape Province				
Damage to Aircraft	Substantial to engine 1				

Location of the incident site with reference to easily defined geographical points (GPS readings if possible)

At Global Positioning System (GPS) co-ordinates determined to be 26º41'46.06" S 27º 3'51.52" E during climb between FL260 and FL270

Meteorological Information	Wind 030°/07kts no clouds visibility 9999m temperature 16°C due point 13°C QNH 1022

Number of People On-board	2+5+157	**Number of People Injured**	0	**Number of People Killed**	0	**Other (On Ground)**	0

Synopsis

On Monday morning, 10 February 2022, a Boeing 737-800 aircraft with registration ZS-ZWD took off on a domestic scheduled flight from Lanseria International Airport (FALA) in Gauteng province to Cape Town International Airport (FACT) in the Western Cape province. On-board the aircraft were two pilots, five cabin crew members and 157 passengers. The flight was conducted under the provisions of Part 121 of the Civil Aviation Regulations (CAR) 2011 as amended.

It was reported that during normal climb after take-off whilst passing flight level (FL) 260, a loud bang was heard. The No.1 engine sustained a severe uncategorised damage. The crew followed the applicable checklists after which a decision was made to divert to O.R. Tambo International Airport (FAOR). An uneventful single-engine landing was conducted on Runway 03R. None of the occupants was injured during the serious incident. The aircraft's left-side leading edge of the horizontal stabiliser sustained damage. On 14 June 2022, the South Gauteng High Court issued a certificate of appointment (see Appendix A) to liquidators to settle all matters relating to Comair Limited. As a result, the engine was not shipped to the manufacturer for a teardown inspection.

The engine borescope inspection revealed internal discolouration and failure of the hot section and its components. Moreover, high-pressure turbine blades were all sheared off, and two blades had broken out of disk. The cause of the engine failure could not be determined due to the operator being in the process of liquidation. On 5 January 2023, the manufacturer wrote to the appointed liquidators and Comair Limited representatives stating that once the new owner takes over, they will provide all requested technical support to the investigation.

Probable Cause/s and/or Contributory Factors

Emergency landing at FAOR due to an in-flight engine failure, which was contained. The engine borescope inspection revealed internal discolouration and failure of the hot section and shearing of high-pressure turbine blades. The cause of the engine failure could not be determined due to the operator being in the process of liquidation. The investigation will be reopened once the new owner takes over the operation.

SRP Date	12 September 2023	Publication Date	20 September 2023

Occurrence Details

Reference Number	**:** CA18/3/21329
Occurrence Category	**:** Serious incident
Type of Operation	**:** Scheduled (Part 121)
Name of Operator	**:** Comair
Aircraft Registration	**:** ZS-ZWD
Aircraft Make and Model	**:** Boeing B737-800
Nationality	**:** South African
Callsign	**:** CAW 451
Place	**:** Flight level 260
Date and Time	**:** 10 February 2022 at 0417Z
Injuries	**:** None
Damage	**:** Substantial

Purpose of the Investigation

In terms of Regulation 12.03.1 of the Civil Aviation Regulations (CAR) 2011, this report was compiled in the interest of the promotion of aviation safety and the reduction of the risk of aviation accidents or incidents and not to apportion blame or liability.

All times given in this report are Co-ordinated Universal Time (UTC) and will be denoted by (Z). South African Standard Time is UTC plus 2 hours.

Investigation Process

The Accident and Incident Investigations Division (AIID) of the South African Civil Aviation Authority (SACAA) was notified of the occurrence on 10 February 2022 at 0417Z. The occurrence was categorised as a serious incident according to the CAR 2011 Part 12 and ICAO STD Annex 13 definitions. The notifications were sent to the State of Registry, Operator, Design and Manufacture in accordance with CAR 2011 Part 12 and ICAO Annex 13 Chapter 4. The State of Design (USA) appointed an accredited representative and advisor. The investigators had dispatched to the incident site for this serious incident.

Notes:

1. *Whenever the following words are mentioned in this report, they shall mean the following:*
   Serious Incident — this investigated serious incident
   Aircraft — the Boeing and B737-800 involved in this serious incident
   Investigation — the investigation into the circumstances of this serious incident
   Pilot — the pilot involved in this serious incident
   Report — this serious incident report

2. *Photos and figures used in this report were taken from different sources and may have been adjusted from the original for the sole purpose of improving clarity of the report. Modifications to images used in this report were limited to cropping, magnification, file compression; or enhancement of colour, brightness, contrast; or addition of text boxes, arrows, or lines.*

Disclaimer

Table of Contents

ABBREVIATION	DESCRIPTION
°	Degrees
°C	Degrees Celsius
AIID	Accident and Incident Investigations Division
AMM	Aircraft Maintenance Manual
AMO	Aircraft Maintenance Organisation
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
BSI	Borescope Inspection
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
CRMA	Certificate Relating to Maintenance
E	East
EGT	Exhaust Gas Temperature
FACT	Cape Town International Airport
FALA	Lanseria Airport
FAOR	O.R. Tambo International Airport
FDR	Flight Data Recorder
FT	Feet
FL	Flight Level
GPS	Global Positioning System
I.A.W	In Accordance With
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
Kts	Knots
KIAS	Indicated Air Speed
METAR	Meteorological Aeronautical Report
MHz	Megahertz
No.	Number
PF	Pilot Flying
PM	Pilot Monitoring
PN	Part Number
QNH	Query Nautical Height
RWY	Runway
S	South
SAAT	South African Airways Technical
SACAR	South African Civil Aviation Regulations
SAWS	South African Weather Service
S/N	Serial Number
TRACON	Terminal Radar Approach Control
UTC	Co-ordinated Universal Time
VREF	Reference Speed
Z	Zulu

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1 On Monday morning, 10 February 2022, a Boeing 737-800 aircraft with registration ZS-ZWD using the call sign Comair (CAW) 451 departed Lanseria International Airport (FALA) in Gauteng province on a scheduled flight to Cape Town International Airport (FACT) in the Western Cape province. This was the first of the three-legged scheduled flights from FALA to FACT. On-board the aircraft were two pilots, five cabin crew and 157 passengers. The flight was conducted under instrument flight rules (IFR) and under the provisions of Part 121 of the Civil Aviation Regulations (CAR) 2011 as amended. At 0405Z, the pilot monitoring requested push back and start to commence the flight. On the flight folio, Transponder 1 was snagged as unserviceable by the previous crew and had given an explanation that *the transponder indicated 'fail' in ground mode but was operational in air mode*. The aircraft was taxied to Runway (RWY) 07 for take-off. The climb to flight level (FL) 80 routing to Xagen waypoint was uneventful.

1.1.2 At 0410Z when ZS-ZWD flew past FL120, the aircraft was transferred from Johannesburg Approach Control to Johannesburg Area Control on frequency 128.3-Megahertz (MHz). Area control communicated the final climb to FL380. The two engines' N1 power settings were at 99.2% (climb thrust) each. During climb, the pilot monitoring exited the cockpit area. At 0418Z, the pilot flying heard a loud bang and the aircraft yawed to the left after passing FL260. The pilot flying stopped the climb between FL260 and FL270 and, thereafter, started monitoring the instruments. He stated that most parameters reflected red, however, they returned to normal (green). About 20 seconds later, the auto pilot disconnected. The pilot flying then realised that the left engine had failed because two warning lights illuminated, indicating '*source off*' and '*drive light not connected*' (the engine had not stopped completely but was running at 20% N1 power, which is associated with severe engine damage). He then pulled back the number 1 thrust lever before declaring MAYDAY on frequency 128.3 MHz, stating that they had an engine failure and were requesting to descend to FL230 (*the aircraft can maintain FL230 on a single engine*). Area control air traffic control (ATC) acknowledged the MAYDAY call and cleared the aircraft to descend to FL230. The ATC then issued an alert phase (Alerfa) notification and advised tower ATC that ZS-ZWD (CAW 451) has an engine failure. Tower ATC, in turn, advised the FAOR Aerodrome Rescue and Firefighting (ARFF) personnel to be on standby for ZS-ZWD. In the cockpit, the pilots (the pilot monitoring had returned as quickly as he could after the engine incident) followed the checklist to shut down the failed engine; thereafter, they followed the manufacturer's checklist and completed the engine shut down process. The pilot indicated that the exhaust gas turbine (EGT) was at 980ºC. Normally at take-off, this is when the EGT is at 950ºC.

1.1.3 The pilot monitoring advised the cabin crew and the passengers about the engine failure and that they were diverting to O.R. Tambo International Airport (FAOR). The ZS-ZWD was given a choice of using either one of the two runways at FAOR, and they chose instrument landing system (ILS) approach RWY 03R. At 0450Z, ZS-ZWD was established on ILS and was transferred to FAOR tower on frequency 121.9 MHz. Thereafter, ZS-ZWD was given clearance to land on first contact; the pilot flying requested to stop to allow fire truck vehicles to inspect the left engine for any fluid leaks or debris coming from the engine. ZS-ZWD landed safely at 0455Z. Three emergency vehicles were given clearance to enter the runway once the aircraft had landed to inspect the engine and the runway. There was no fluid leak or visible debris from the engine. ZS-ZWD, whilst followed by emergency vehicles, proceeded to the parking bay for a complete engine shut down. The crew and the passengers disembarked from the aircraft safely thereafter. The aircraft sustained damage to the engine and the left-side leading edge of the horizontal stabiliser.

1.1.4 The incident occurred in the morning at Global Positioning System (GPS) co-ordinates determined to be 26º 28.9' South 027º05.7' East during the climb phase whilst passing FL260 for FL380.

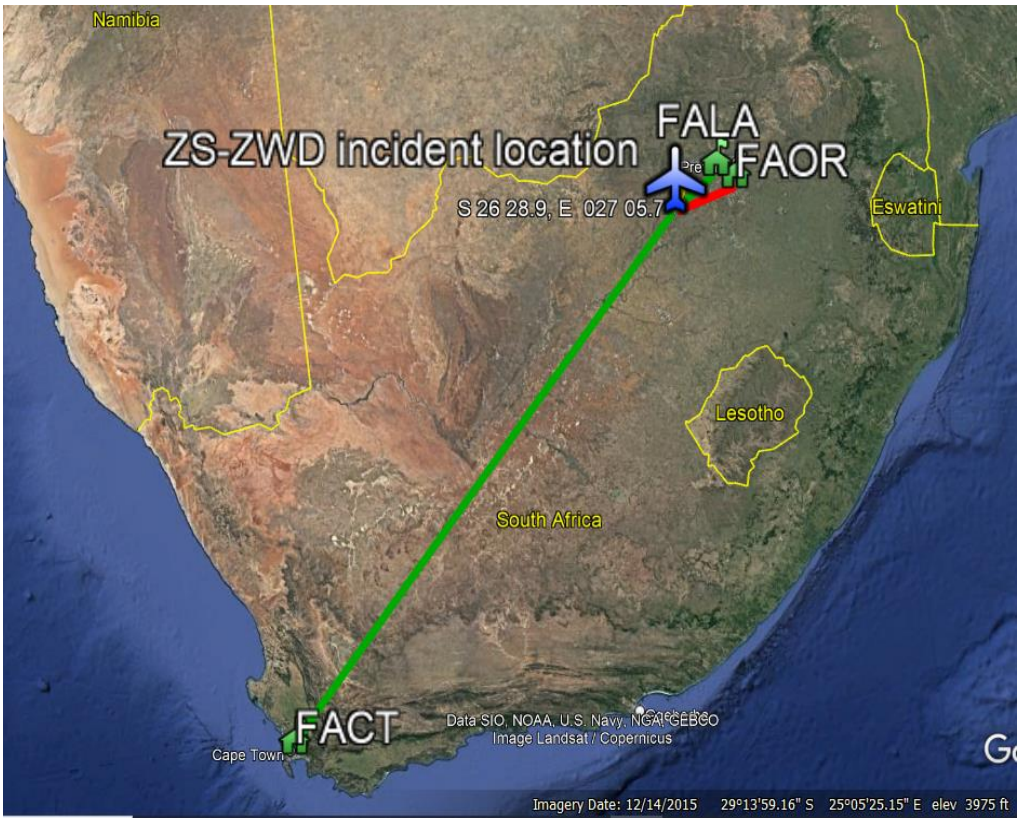


Figure 1: Position of the aircraft along its route where it made an air turn back to FAOR. (Source: Google Earth)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	2	5	157	164	-
Total	**2**	**5**	**157**	**164**	**-**

Note: Other means people on the ground.

1.3. Damage to Aircraft

1.3.1. The No.1 engine and left-side leading edge of the horizontal stabiliser were damaged.

Figure 2: The damaged engine after it was removed from the aircraft.

1.4. Other Damage

1.4.1 None.

1.5. Personnel Information

Pilot Flying (PF) – Pilot-in-command

Nationality	South African	Gender	Male	Age	43
Licence Type		Airline Transport Pilot Licence (ATPL)			
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument, Night Flight, Flight Examiner and Grade I Flight Instructor				
Medical Expiry Date	31 July 2022				
Restrictions	None				
Previous Incidents	None				

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this incident.

Flying Experience:

Total Hours	12117
Total Past 24 Hours	2
Total Past 7 Days	11.8
Total Past 90 Days	128
Total on Type Past 90 Days	95.3
Total on Type	7928

1.5.1 The pilot flying was initially issued an Airline Transport Pilot Licence (ATPL) on 26 May 2005. His last licence revalidation was on 16 June 2021 with an expiry date of 31 August 2022. His last proficiency check was certified on 5 December 2021.

1.5.2 The pilot flying was issued Class 1, 2 and 4 medical certificates on 6 July 2021. Class 1 with an expiry date of 31 July 2022, Class 2 with an expiry date of 31 July 2023 and Class 4 with an expiry date of 31 July 2024.

Pilot Monitoring (PM) – First Officer

Nationality	South African	Gender	Male	Age	36
Licence Type		Airline Transport Pilot Licence (ATPL)			
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument and Night rating				
Medical Expiry Date	30 September 2022				
Restrictions	None				
Previous Incidents	None				

Flying Experience:

Total Hours	7491.18
Total Past 24 Hours	4.08
Total Past 7 Days	18.08
Total Past 90 Days	163.22
Total on Type Past 90 Days	163.22
Total on Type	2471.22

1.5.3 The pilot monitoring was initially issued an Airline Transport Pilot Licence (ATPL) on 13 October 2015. His last licence revalidation was on 14 June 2021 with an expiry date of 30 June 2022 and his last proficiency check was on 5 December 2021.

1.5.4 The pilot was issued Class 1, 2 and 4 medical certificates on 10 September 2021. Class 1 with an expiry date of 30 September 2022, Class 2 with an expiry date of 30 September 2026 and Class 4 with an expiry date of 30 September 2026.

1.6. Aircraft Information

1.6.1 The Boeing 737-800 is a low-wing, narrow body, single-aisle jet transport aircraft powered by two high bypass CFM56-7B26 turbofan engines mounted on pylons beneath the wings. The aircraft is designed to operate with two pilots and six cabin crew. The aircraft is designed to carry a maximum of 189 passengers.

Airframe:

Type	Boeing 737-800	
Serial Number	40855	
Manufacturer	Boeing Aircraft Corporation	
Date of Manufacture	2000	
Total Airframe Hours (At Time of Accident)	25231.02	
Last MPI (Date & Hours)	19 January 2022	25069.55
Hours Since Last MPI	161.47	
C of A (Issue Date)	19 December 2012	
C of A Expiry Date	31 December 2022	
C of R (Issue Date) (Present Owner)	18 December 2012	
Type of Fuel Used in the Aircraft	Jet A1	
Previous Incidents	Unknown	

Note: Previous accidents refer to past accidents the pilot was involved in, when relevant to this incident.

1.6.2 According to available information, the aircraft was first registered to the present owner on 18 December 2012. The aircraft was reissued a Certificate of Release to Service (CRS) on 19 January 2022 with an expiry date of 14 August 2022 or at 25669.55 hours, whichever occurs first.

1.6.3 Based on the aircraft maintenance records, the last mandatory periodic inspection (MPI) A-check was conducted on 19 January 2022 at 25069.55 airframe hours. The aircraft had accumulated an additional 161.47 airframe hours in operation since the last inspection.

Engine 1:

Manufacturer/Model	CFM 56
Serial Number	962424
Part Number	CF56-7BE
Hours Since New	25232.46
Hours Since Overhaul	TBA

1.6.4 Based on the available information, the No.1 engine full hot section borescope inspection (BSI) was last certified on 10 May 2021, and it was certified IAW the Boeing 737-800 Aircraft Maintenance Manual (AMM) Revision 74. The BSI was certified IAW the maintenance planning document (MPD) interval.

The following were observed during the inspection:

- Fuel Nozzles:

Several deflectors with slight material loss on the edges, all were found to be within the limits IAW AMM 72-00-00-200-805-F00.

- Combustion Chambers:

Inner liner: Nil defects were found.

Outer liner: Nil defects were found IAW AMM 72-00-00-200-805-F00.

- Nozzle Guide Vanes:

Higher pressure (HP) nozzle guide vane (NGV): Nil defects were found IAW AMM 72-00-00-220-801-F00 & 72-00-00-200-818-F00.

Figure 3: All blades sheared off. Two blades broke out of disk. (Source SAAT)

- High Turbine Blades: **(AMM 72-00-00-200-807-F00)**
- Two blades broke out of disk.

Slight contact was evident at the tips; all were found to be within the limits IAW AMM 72-00-00-200-807-F00.

1.6.5 After the BSI was conducted, the engine was certified to remain in service with no BSI limitations.

Engine 2:

Manufacturer/Model	CFM 56
Serial Number	962446
Part Number	CF56-7BE
Hours Since New	25329.09
Hours Since Overhaul	TBA

1.7. Meteorological Information

1.7.1 The weather information entered in the table below was sourced from FAOR for the day and time of the serious incident.

Wind Direction	030°	Wind Speed	07	Visibility	9999m
Temperature	16ºC	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	13ºC	QNH	1022		

1.8. Aids to Navigation

1.8.1 The aircraft was equipped with standard navigational equipment as approved by the Regulator (SACAA) for the aircraft type. There were no records indicating that the navigational equipment was unserviceable prior to the serious incident.

1.9. Communication

1.9.1 The aircraft was equipped with standard communication equipment as per the MEL approved by the Regulator. There were no recorded defects prior to or during the serious incident.

1.10. Aerodrome Information

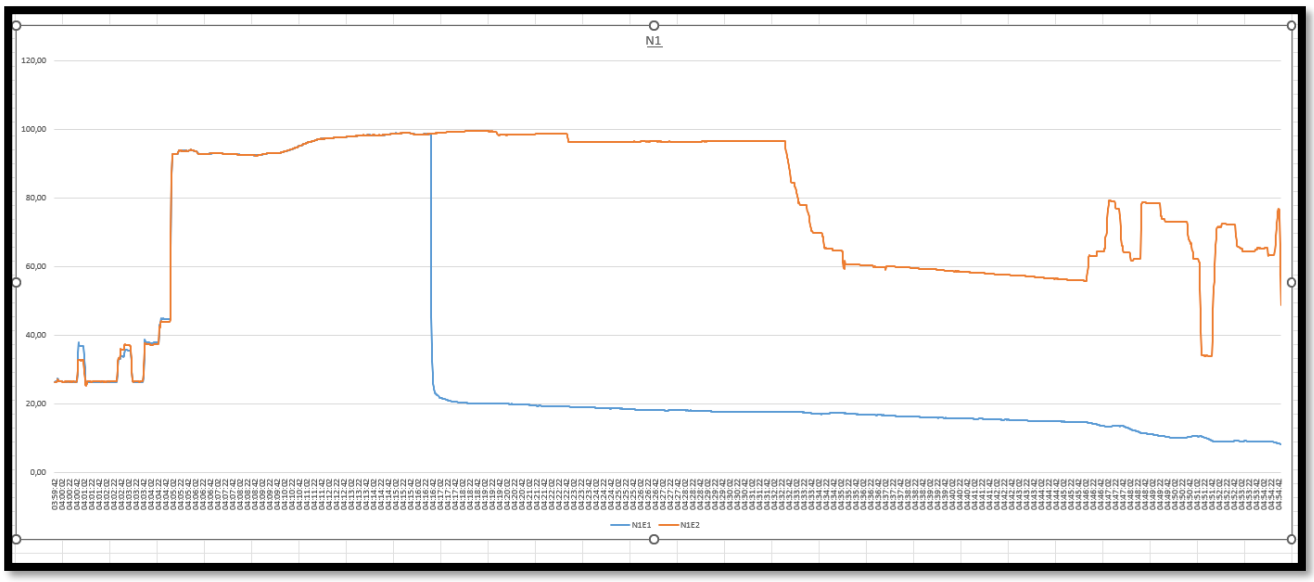
Aerodrome Location	O.R. Tambo International Aerodrome (FAOR)
Aerodrome Status	Licensed
Aerodrome Altitude	5 558ft
Runway Headings	03L/21R, 03R/21L
Runway Dimensions	4 421m x 60m, 3 405m x 60m
Runway Used	03R
Runway Surface	Asphalt
Approach Facilities	Runway lights, PAPI, DVOR / DME (JSV), ILS LOC and ILS GP for both runways
Radio Frequency	121.9 MHz

1.11. Flight Recorders

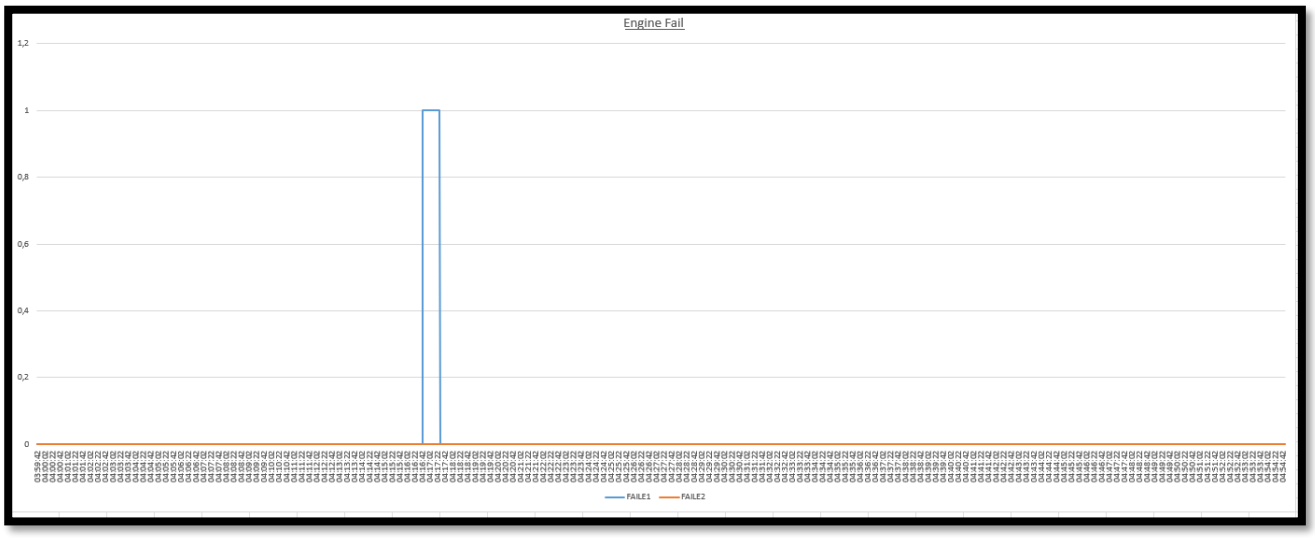
1.11.1 The aircraft was fitted with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR) as required by the CAR 2011, Part 121.05. The FDR and the CVR circuit breakers (CBs) were pulled out to protect the information and the recorders were removed from the aircraft on 10 February 2022. Both the FDR and the CVR were successfully downloaded on 11 February 2022 at an approved aircraft maintenance organisation (AMO) in the presence of the investigators. The transcript from the CVR was not conducted as the investigating team deemed the available information adequate for the report.

FDR information:

- Manufacturer: Honeywell
- Type: Solid-State Digital Flight recorder
- Part Number: 980-4750-003
- Serial Number: FDR-07800
- Date of manufacture: November 2018

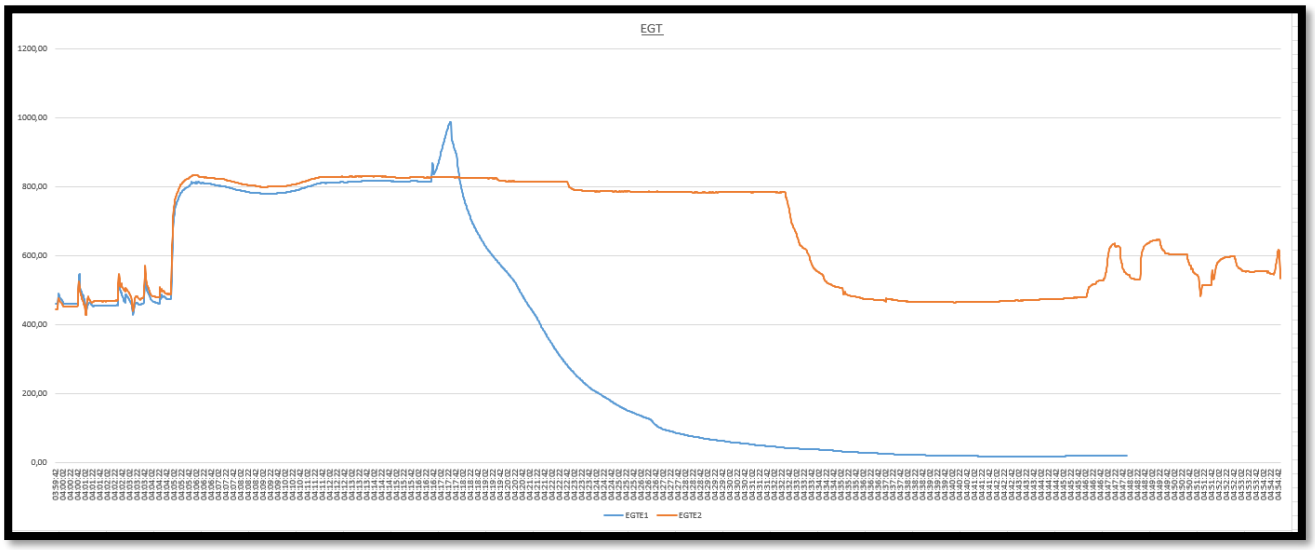


Graph1: Blue line shows the left engine's VN1T and yellow line, the right engine's VN1T. (Source: SAAT)



Graph 2: Engine failure. (Source: SAAT)

1.11.2 The FDR data Graphs 1, 2 and 3 show that the left engine failed at 04:17:30Z at an altitude of 26034 feet (ft) and that the exhaust gas temperature shot up from 800ºC to approximately 1000ºC briefly before dropping sharply to zero.



Graph 3: Rise in temperature on engine 1, followed by a sudden drop. (Source: SAAT)

CVR information:

- Manufacturer: Honeywell
- Type: Solid-State Cockpit voice reorder
- Part Number: 980-6032001
- Serial Number: CVR-03780
- Date of manufacture: August 2015

1.12 Wreckage and Impact Information

1.12.1 During the climb phase, there was a loud bang with subsequent vibration on the aircraft. Relevant checklists were referenced, and the No.1 engine was shut down and secured as per the Boeing 737-800 Quick Reference Handbook (QRH), after which a MAYDAY was declared. A decision was made to divert to FAOR. The aircraft landed safely with one engine in operation on Runway 03R. The No.1 engine was severely damaged.

1.12.2 On-site investigation revealed the following: the fan blades were undamaged and still intact in their respective positions with no evidence of foreign object debris (FOD) ingestion. The compressor and the stator blades were still intact in their respective positions.

Figure 4: No damage to the compressor fan blades.

Figure 5: The compressor and the stator blades.

1.12.3 The turbine rotor blades were found damaged with cuts almost at the same height all round.

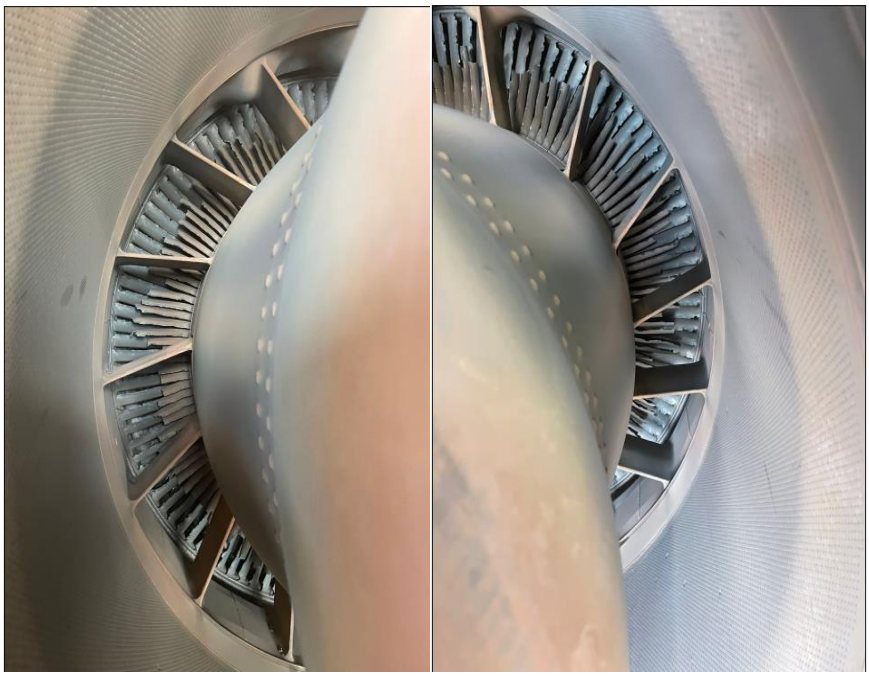


Figure 6: Damaged turbine rotor blades.

1.12.4 The left-side leading edge of the horizontal stabiliser was pierced by debris from the engine.

Figure 7: Left side horizontal stabiliser.

1.13 Medical and Pathological Information

1.13.1 None.

1.14 Fire

1.14.1 There was no evidence of a pre- or post-impact fire.

1.15 Survival Aspects

1.15.1 The serious incident was considered survivable as no damage was caused to the cockpit and cabin structure of the aircraft.

1.16 Tests and Research

1.16.1 The engine borescope inspection revealed the internal discolouration and failure of the hot section and its components. Further investigation and testing on the failed engine could not be conducted due to the operator being liquidated. The investigation will be reopened once the new owner takes over the operation.

1.17 Organisational and Management Information

1.17.1 The flight was conducted in accordance with the provisions of Part 121 (Commercial) of the CAR 2011 as amended.

1.17.2 The AMO which certified the last maintenance inspection (annual inspection) prior to the accident flight had an approved AMO certificate that was issued by the Regulator on 27 October 2021 with an expiry date of 31 October 2022.

1.17.3 The operator had an approved Class 1 Air Service Licence No. S066D for domestic schedule, which was issued on 12 August 2015 by the Department of Transport. The licence authorised the carrier to operate under the following categories: Type S1 – transport of passengers between two or more specified points, and Type S2 – transport of cargo or mail between two or more specified points. The aircraft used under this operation should meet category A1 provisions – any aircraft, excluding a helicopter, with a maximum certificated mass exceeding 20 000 kilograms.

1.17.4 The operator had an Air Operating Certificate (AOC) which was issued on 3 May 2021 by the Regulator with an expiry date of 30 April 2022. The aircraft was duly authorised to operate under the AOC.

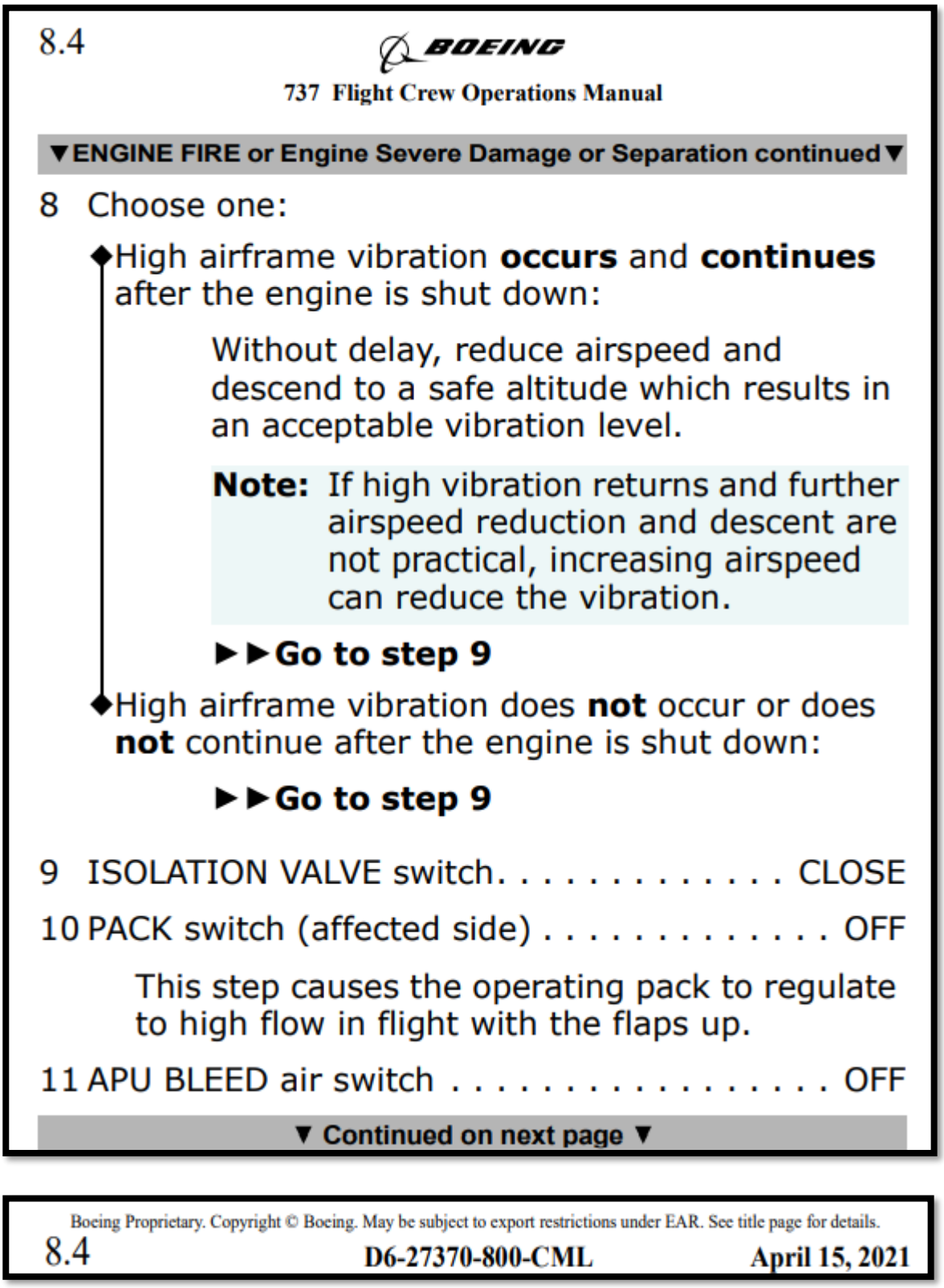
1.17.5 The last audit was conducted from 23 to 26 March 2021 by the Regulator. The scope of the audit conducted was to determine whether the approval could be renewed in terms of the requirements stipulated in the Aviation Legislation in South Africa and Part 121 of the CAR 2011 as amended. The audit resulted in no findings.

1.18 Additional Information

1.18.1 According to the Boeing 737 QRH, the Engine Fire or Engine Severe Damage or Separation checklists should be referenced if an engine fire warning, airframe vibrations with abnormal engine indications, and/or an engine separation occurs (see Figure 8 to 11 for the four-page checklist which has 17 items). The first five items on the checklist were quick reference items (time-sensitive).

1.18.2 The crew followed the Engine Severe Damage or Separation Non-normal checklist to avoid confusion.

1.18.3 The following information is an extract from the Boeing 737 Flight Crew Operations:



8.4

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▼ENGINE FIRE or Engine Severe Damage or Separation continued▼

8 Choose one:

◆High airframe vibration **occurs** and **continues** after the engine is shut down:

Without delay, reduce airspeed and descend to a safe altitude which results in an acceptable vibration level.

Note: If high vibration returns and further airspeed reduction and descent are not practical, increasing airspeed can reduce the vibration.

►►**Go to step 9**

◆High airframe vibration does **not** occur or does **not** continue after the engine is shut down:

►►**Go to step 9**

9 ISOLATION VALVE switch. . . . . CLOSE

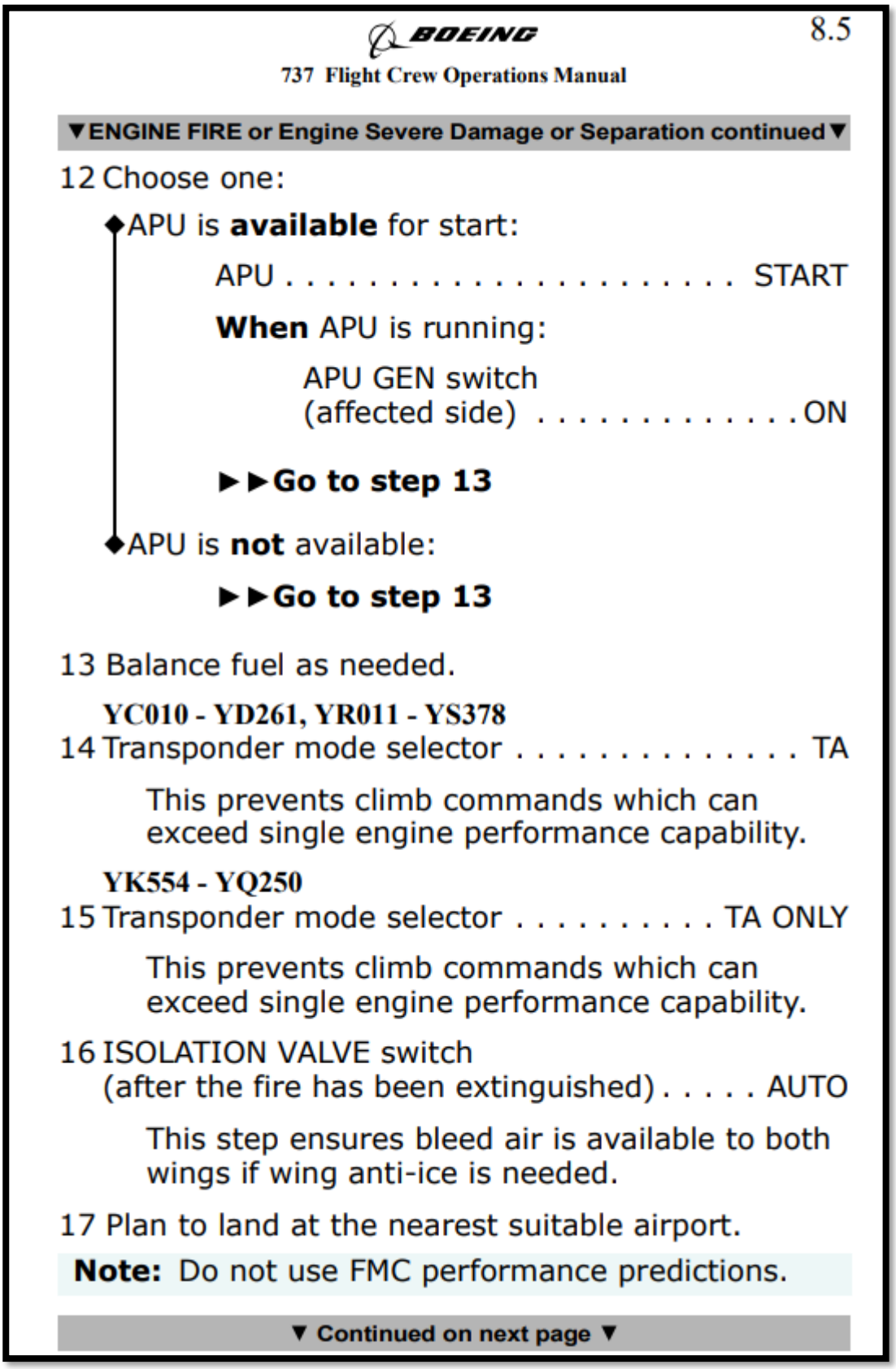
10 PACK switch (affected side) . . . . . OFF

This step causes the operating pack to regulate to high flow in flight with the flaps up.

11 APU BLEED air switch . . . . . OFF

▼ Continued on next page ▼

Figure 8: Page 1 of the QRH. (Source: Boeing)
Note: Copyright © Boeing (reproduced with permission)



▼ENGINE FIRE or Engine Severe Damage or Separation continued▼

12 Choose one:

◆APU is **available** for start:

APU . . . . . START

When APU is running:

APU GEN switch
(affected side) . . . . . ON

►►**Go to step 13**

◆APU is **not** available:

►►**Go to step 13**

13 Balance fuel as needed.

YC010 - YD261, YR011 - YS378

14 Transponder mode selector . . . . . TA

This prevents climb commands which can exceed single engine performance capability.

YK554 - YQ250

15 Transponder mode selector . . . . . TA ONLY

This prevents climb commands which can exceed single engine performance capability.

16 ISOLATION VALVE switch
(after the fire has been extinguished) . . . . . AUTO

This step ensures bleed air is available to both wings if wing anti-ice is needed.

17 Plan to land at the nearest suitable airport.

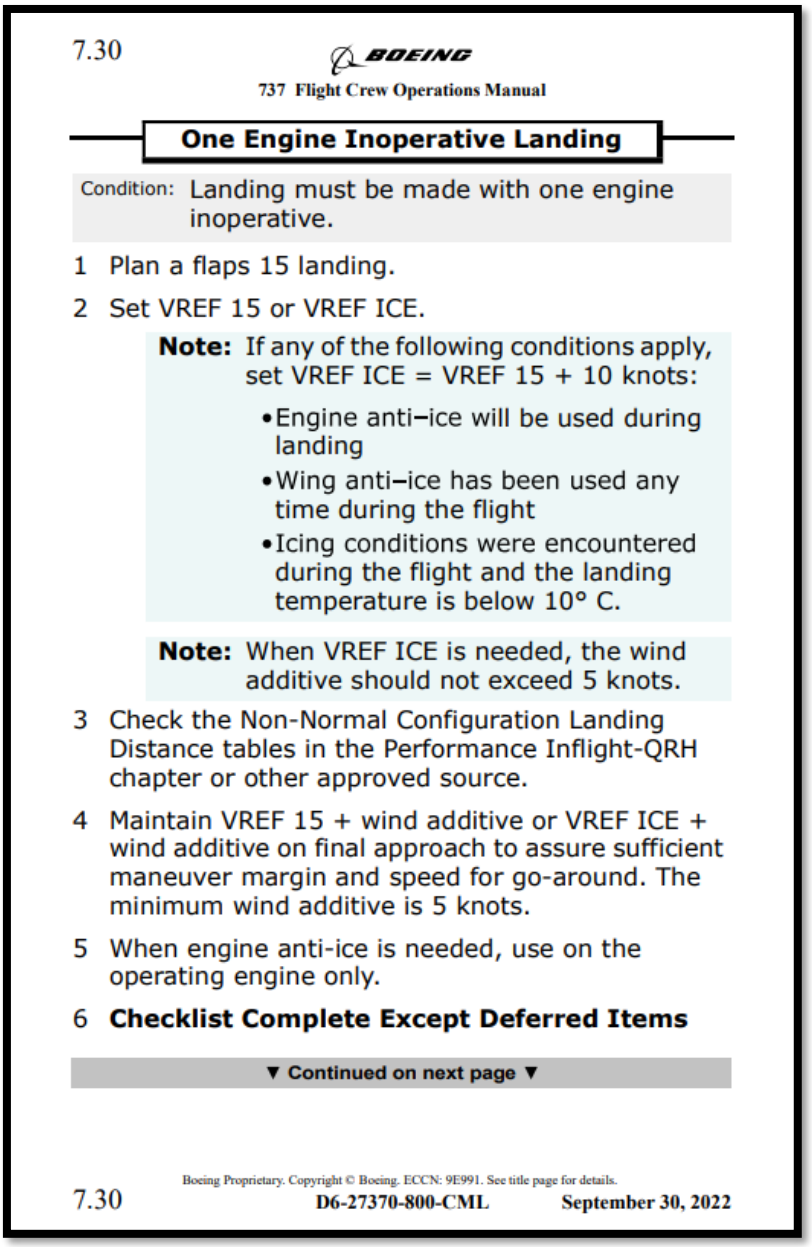
Note: Do not use FMC performance predictions.

▼ Continued on next page ▼

Figure 9: Page 2 of the QRH. (Source: Boeing)
Note: Copyright © Boeing (reproduced with permission)

1.18.3 One Engine Inoperative Landing:

Flight crew members were directed after step 17 of the Engine Fire or Engine Severe Damage or Separation checklist to refer to One Engine Inoperative Landing checklist.



7.30

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737 Flight Crew Operations Manual

One Engine Inoperative Landing

Condition: Landing must be made with one engine inoperative.

1 Plan a flaps 15 landing.

2 Set VREF 15 or VREF ICE.

Note: If any of the following conditions apply, set VREF ICE = VREF 15 + 10 knots:

- Engine anti–ice will be used during landing
- Wing anti–ice has been used any time during the flight
- Icing conditions were encountered during the flight and the landing temperature is below 10° C.

Note: When VREF ICE is needed, the wind additive should not exceed 5 knots.

3 Check the Non-Normal Configuration Landing Distance tables in the Performance Inflight-QRH chapter or other approved source.

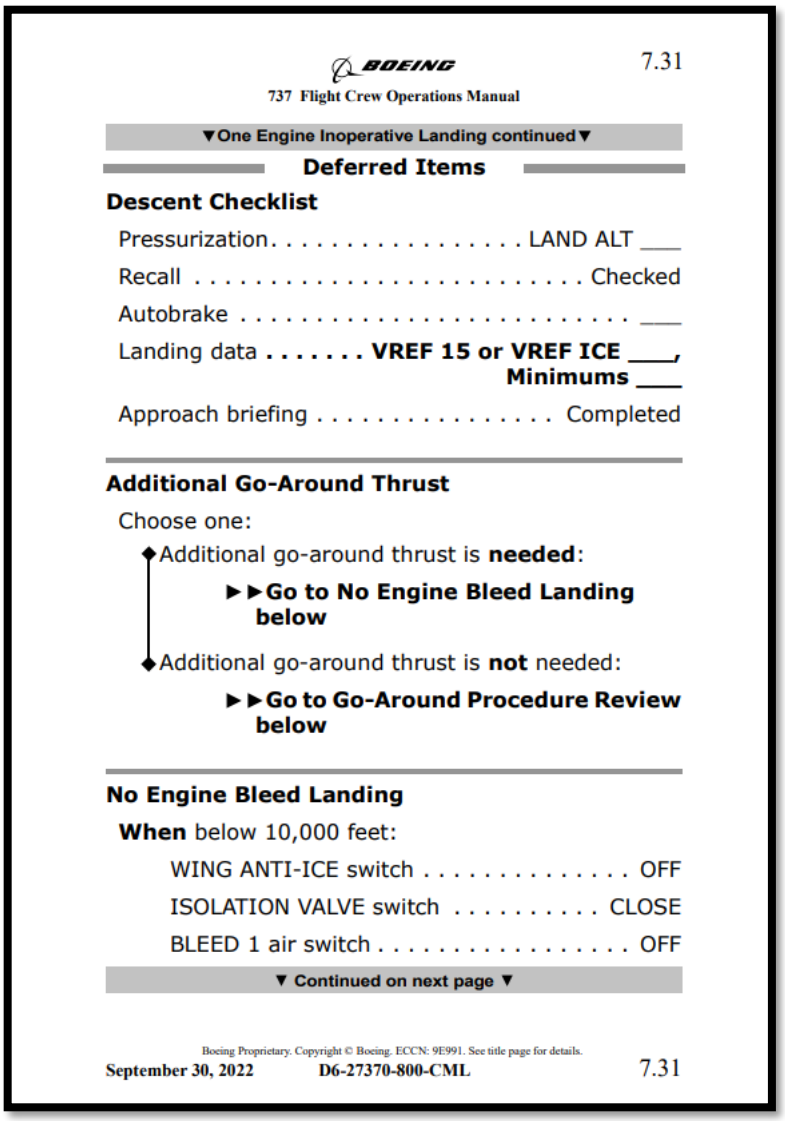
4 Maintain VREF 15 + wind additive or VREF ICE + wind additive on final approach to assure sufficient maneuver margin and speed for go-around. The minimum wind additive is 5 knots.

5 When engine anti-ice is needed, use on the operating engine only.

6 **Checklist Complete Except Deferred Items**

▼ Continued on next page ▼

Figure 10: Page 3 of the QRH. (Source: Boeing)
Note: Copyright © Boeing (reproduced with permission)



BOEING 7.31

737 Flight Crew Operations Manual

▼One Engine Inoperative Landing continued▼

Deferred Items

Descent Checklist

Pressurization . . . . . LAND ALT ___

Recall . . . . . Checked

Autobrake . . . . . ___

Landing data . . . . . **VREF 15 or VREF ICE ___, Minimums ___**

Approach briefing . . . . . Completed

Additional Go-Around Thrust

Choose one:

◆Additional go-around thrust is **needed**:

►►**Go to No Engine Bleed Landing below**

◆Additional go-around thrust is **not** needed:

►►**Go to Go-Around Procedure Review below**

No Engine Bleed Landing

When below 10,000 feet:

WING ANTI-ICE switch . . . . . OFF

ISOLATION VALVE switch . . . . . CLOSE

BLEED 1 air switch . . . . . OFF

▼ Continued on next page ▼

Figure 11: Page 4 of the QRH. (Source: Boeing)
Note: Copyright © Boeing (reproduced with permission)

1.19 Useful or Effective Investigation Techniques

1.19.1 None.

2. ANALYSIS

2.1. General

From the available evidence, the following analysis was made with respect to this incident. This shall not be read as apportioning blame or liability to any organisation or individual.

2.2. Analysis

2.2.1. Based on the crew qualifications and medical reports, there was no evidence that the crew suffered any illness, physiological factors or incapacitation that might have affected their

ability to control the aircraft. The crew communicated with ATC and followed the emergency checklist and landed the aircraft safely without further damage.

2.2.2. There were no pre-existing defects recorded on the airframe or engine logbook/s that were noticed during the investigation which could have affected normal flight. From the evidence gathered during the investigation and further inspection of the airframe and the engine, it was concluded that the airframe did not have any pre-existing damage that would have adversely influenced its controllability. All damage sustained by the aircraft was attributed to engine failure. The operator's AMO is based at FAOR and, therefore, this was a logical diversion for the crew.

2.2.3. Fine weather conditions prevailed at the time of the incident. The weather had no bearing on this serious incident.

3. CONCLUSION

3.1. General

From the available evidence, the following findings, causes and contributing factors were made with respect to this incident. These shall not be read as apportioning blame or liability to any organisation or individual.

To serve the objective of this investigation, the following sections are included in the conclusion heading:

- **Findings —** are statements of all significant conditions, events, or circumstances in this incident. The findings are significant steps in this incident sequence, but they are not always causal or indicate deficiencies.
- **Causes —** are actions, omissions, events, conditions, or a combination thereof, which led to this incident.
- **Contributing factors —** are actions, omissions, events, conditions, or a combination thereof, which, if eliminated, avoided or absent, would have reduced the probability of the incident occurring, or would have mitigated the severity of the consequences of the incident. The identification of contributing factors does not imply the assignment of fault or the determination of administrative, civil, or criminal liability.

3.2. Findings

3.2.1 The pilot flying had an Airline Transport Pilot Licence (ATPL) that was initially issued on 26 May 2005 with an expiry date of 31 August 2022. The aircraft type was endorsed on his licence. He also had a Class 1, 2 and 4 aviation medical certificates that were issued on 6 July 2021 with the final expiry date of 31 July 2024.

3.2.2 The pilot monitoring had an Airline Transport Pilot Licence (ATPL) that was initially issued on 13 October 2015 with an expiry date of 30 June 2022. The aircraft type was endorsed on his licence. He also had a Class 1, 2 and 4 aviation medical certificates that were issued on 10 September 2021 with the final expiry date of 30 September 2026.

3.2.3 The flight was conducted in accordance with the provisions of Part 121 of the South African CAR 2011 as amended.

3.2.4 The aircraft was first registered to the current owner on 18 December 2012. The aircraft was issued the Certificate of Airworthiness (C of A) on 19 December 2012 with an expiry date of 31 December 2022. The aircraft was reissued a Certificate of Release to Service (CRS) on 19 January 2022 with an expiry date of 14 August 2022 or at 25669.55 airframe hours, whichever occurs first.

3.2.5 The operator had an approved Class 1 Air Service Licence No. S066D for domestic schedule, which was issued on 12 August 2015 by the Department of Transport. The licence authorised the carrier to operate under the following categories: Type S1 – transport of passengers between two or more specified points, and Type S2 – transport of cargo or mail between two or more specified points. The aircraft used under this operation should meet category A1 provisions – any aircraft, excluding a helicopter, with a maximum certificated mass exceeding 20 000 kilograms.

3.2.6 The AMO which certified the last maintenance inspection (annual inspection) prior to the accident flight had an approved AMO certificate that was issued by the Regulator on 27 October 2021 with an expiry date of 31 October 2022.

3.2.7 The last MPI A-check was conducted on 19 January 2022 at 25069.55 airframe hours. The aircraft had accumulated an additional 161.47 airframe hours in operation since the last inspection

3.2.8 The aircraft was fitted with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR) as required by the CAR 2011, Part 121.05. Both the FDR and the CVR were successfully downloaded on 11 February 2022 at an approved aircraft maintenance organisation (AMO) in the presence of the investigators. The transcript from the CVR was not conducted as the investigating team deemed the available information adequate for the report.

3.2.9 The last BSI on engine No.1 was completed on 10 May 2021 and it was certified IAW the Boeing 737-800 AMM Revision 74. The BSI was certified IAW the maintenance planning document (MPD) interval. The following were observed during the inspection:

- Fuel Nozzles:
  Several deflectors with slight material loss on the edges, all were found to be within the limits IAW AMM 72-00-00-200-805-F00.
- Combustion Chambers:
  Inner liner: Nil defects were found.
  Outer liner: Nil defects were found IAW AMM 72-00-00-200-805-F00.

- Nozzle Guide Vanes:
  Higher pressure (HP) nozzle guide vane (NGV): Nil defects were found IAW AMM 72-00-00-220-801-F00 & 72-00-00-200-818-F00.
- High Turbine Blades:
- All blades were sheared off and two blades were broken out of disk IAW AMM 72-00-00-200-807-F00.

3.2.10 The aircraft had a defect: transponder 1 was unserviceable in ground mode but was operational in air mode. The aircraft had two transponders and, IAW the MEL KEF 34-18-02B, it was allowed (cleared) to undertake flight with a single transponder.

3.2.11 The aircraft landed safely on RWY 03R at FAOR. Upon landing, fire-fighting personnel inspected it for any fluid leakage or debris. No visible damage or leaks were noted. The runway was inspected and nothing out of the norm was found; it was declared safe thereafter.

3.2.12 Fine weather conditions prevailed at the time of the flight. The weather had no bearing to this serious incident.

3.2.13 On 14 June 2022, the South Gauteng High Court issued a certificate of appointment to liquidators (see Appendix A) to settle all matters relating to Comair Limited.

3.2.14 The investigator has reviewed the maintenance records of the engine. At this stage, there are no adverse findings.

3.2.15 The manufacturer (CFM) has advised the liquidators that they cannot conduct any work without any agreement from the owner. As such, CFM's position will remain unchanged until there is a new owner. Once such owner agrees to proceed with the repairs of the engine, then CFM will provide any requested technical support to the investigation.

3.3. Probable Cause/s

3.3.1 Emergency landing at FAOR due to an in-flight engine failure, which was contained. The

borescope inspection of the engine revealed internal discolouration and failure of the hot section and shearing of high-pressure turbine blades. The cause of the engine failure could not be determined due to the operator being liquidated. The investigation will be reopened once the new owner takes over the operation.

3.4. Contributory Factor/s

3.4.1. None.

4. SAFETY RECOMMENDATIONS

4.1. General

The safety recommendations listed in this report are proposed according to paragraph 6.8 of Annex 13 to the Convention on International Civil Aviation and are based on the conclusions listed in heading 3 of this report. The AIID expects that all safety issues identified by the investigation are addressed by the receiving States and organisations.

4.2. Safety Recommendation/s

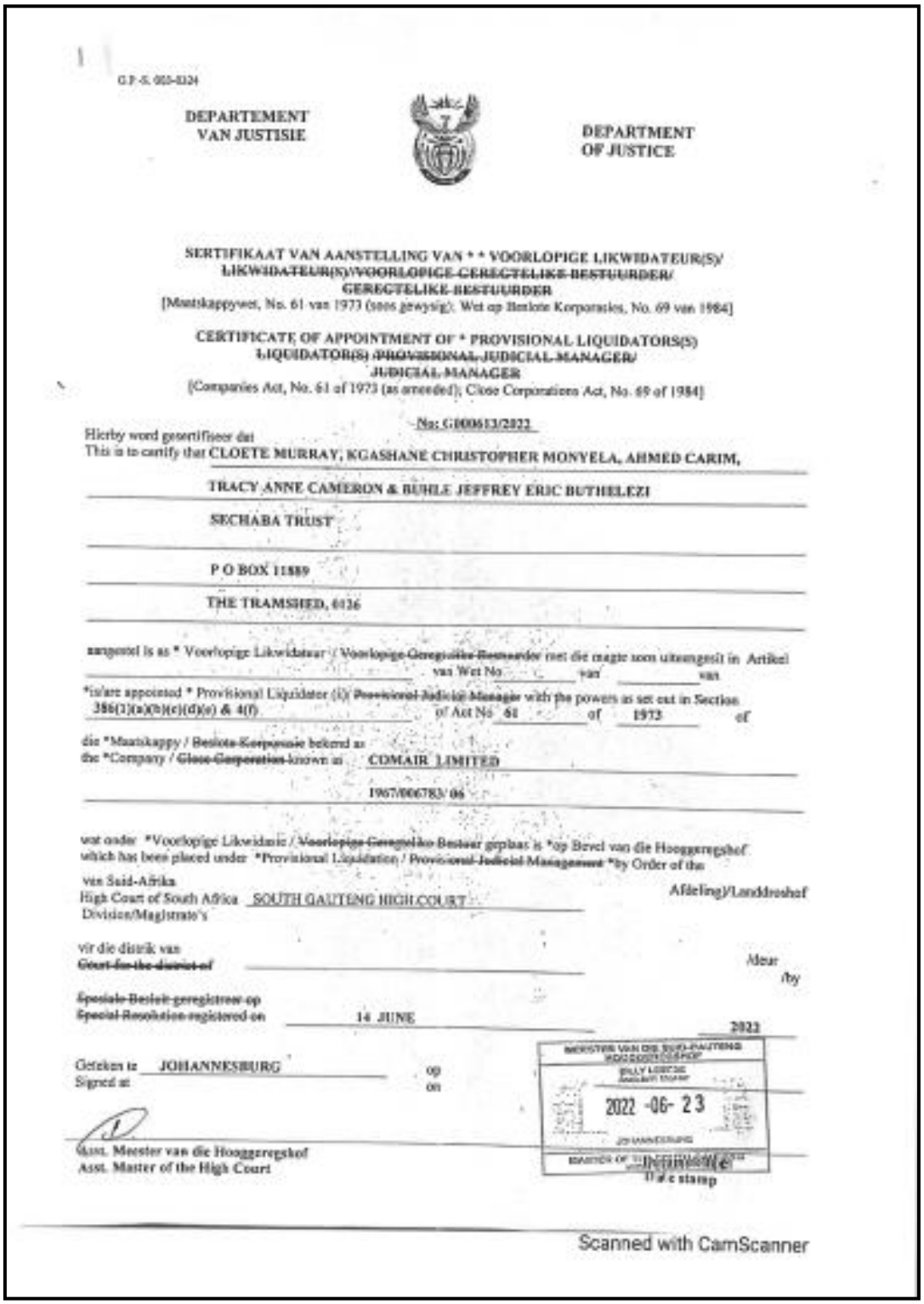
4.2.1. None.

5. APPENDICES

5.1. Appendix A – High Court Certificate of Appointment of Provisional Liquidators

This report is issued by:
Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa

Appendix A



G.P.-S. 005-8324

DEPARTEMENT VAN JUSTISIE

DEPARTMENT OF JUSTICE

SERTIFIKAAT VAN AANSTELLING VAN * * VOORLOPIGE LIKWIDATEUR(S)/ ~~LIKWIDATEUR(S)/VOORLOPIGE GERECHTELIKE BESTUURDER/~~ GERECHTELIKE BESTUURDER
[Maatskappywet, No. 61 van 1973 (soos gewysig); Wet op Beslote Korporasies, No. 69 van 1984]

CERTIFICATE OF APPOINTMENT OF * PROVISIONAL LIQUIDATORS(S) ~~LIQUIDATOR(S) PROVISIONAL JUDICIAL MANAGER/~~ JUDICIAL MANAGER
[Companies Act, No. 61 of 1973 (as amended); Close Corporations Act, No. 69 of 1984]

No: G000613/2022

Hierby word gesertifiseer dat
This is to certify that CLOETE MURRAY, KGASHANE CHRISTOPHER MONYELA, AHMED CARIM, TRACY ANNE CAMERON & BUHLE JEFFREY ERIC BUTHELEZI

SECHABA TRUST

P O BOX 11889

THE TRAMSHED, 0126

aangestel is as * Voorlopige Likwidateur / ~~Voorlopige Geregtelike Bestuurder~~ met die magte soos uiteengesit in Artikel 386(1)(a)(b)(c)(d)(e) & 4(f) van Wet No 61 van 1973 van

*is/are appointed * Provisional Liquidator (s) ~~Provisional Judicial Manager~~ with the powers as set out in Section 386(1)(a)(b)(c)(d)(e) & 4(f) of Act No 61 of 1973 of

die *Maatskappy / ~~Beslote Korporasie~~ bekend as
the *Company / ~~Close Corporation~~ known as COMAIR LIMITED

1967/006783/ 06

wat onder *Voorlopige Likwidasie / ~~Voorlopige Geregtelike Bestuur~~ geplaas is *op Bevel van die Hooggeregshof
which has been placed under *Provisional Liquidation / ~~Provisional Judicial Management~~ *by Order of the

van Suid-Afrika
High Court of South Africa SOUTH GAUTENG HIGH COURT Afdeling/Landdroshof
Division/Magistrate's

vir die distrik van
~~Court for the district of~~ Meur
/by

~~Spesiale Besluit geregistreer op~~
~~Special Resolution registered on~~ 14 JUNE 2022

Geteken te JOHANNESBURG op
Signed at on

MEESTER VAN DIE SUID-GAUTENG HOOGGEREGSHOF
BILLY LORCH
2022 -06- 23
JOHANNESBURG

Asst. Meester van die Hooggeregshof
Asst. Master of the High Court

Insurance Free stamp

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