

AIRCRAFT SERIOUS INCIDENT REPORT AND EXECUTIVE SUMMARY

				Reference:		CA18/3/2/1454	
Aircraft Registration	ZS-OUV	Date of Incident	22 August 2024		Time of Incident	1445Z	
Type of Aircraft	Embraer ERJ-135LR		Type of Operation		Air Transport Operation, Passenger (Part 121)		
Pilot-in-command Licence Type	Airline Transport Pilot Licence		Age	31	Licence Valid	Yes	
Pilot-in-command Flying Experience	Total Flying Hours		4 182.3	Hours on Type	1 257.8		
Last Point of Departure	O. R. Tambo International Aerodrome (FAOR), Gauteng Province						
Next Point of Intended Landing	Sishen Airport (FASS), Northern Cape Province						
Damage to Aircraft	None						
Location of the incident site with reference to easily defined geographical points (GPS readings if possible)							
Abeam Potchefstroom during the climb phase whilst passing flight level 245 (GPS position 26° 51'63" South 027°2 5'23" East)							
Meteorological Information	Wind direction: 280°/2kts; Temperature: 26°C; Dew point: 15°C; CAVOK						
Number of People On-board	2+1+14	Number of People Injured	0	Number of People Killed	0	Other (On the Ground)	0

Synopsis

On Thursday afternoon, 22 August 2024, an Embraer ERJ-135LR aircraft with registration ZS-OUV took off on a scheduled flight number 4Z779 from O.R. Tambo International Aerodrome (FAOR) in Gauteng province to Sishen Airport (FASS) in the Northern Cape province. Three crew members (comprising two pilots and one flight attendant) and 14 passengers were on-board the aircraft. The captain was the pilot flying (PF), and the first officer (FO) was the pilot monitoring (PM). The aircraft took off from Runway 21R at 1354Z. Whilst overhead Potchefstroom in North West province at 24 500 feet (ft) and still climbing to 33 000 ft as per the flight plan, the crew noticed a burning smell in the cockpit. After a few minutes, they observed white smoke that emanated from the number one louver vent. The crew donned their oxygen masks and continued to climb to 24 600 ft having confirmed with air traffic control (ATC). After referencing the aircraft's Quick Reference Handbook (QRH), they switched off the recirculation fan and the smoke dissipated. Later, the FO declared an emergency by broadcasting a "PAN PAN PAN" and the PF flew the aircraft back to FAOR. The Airport Rescue and Firefighting (ARFF) personnel at FAOR were on standby. Approximately 51 minutes after the initial take-off, the aircraft landed safely on Runway 21L. The ARFF personnel inspected the aircraft for signs of external damage, and none was found. The passengers and the crew were not injured.

The investigation revealed that the recirculation fan is required to be inspected every 30 months or at 5000 hours during the C-check inspection; however, this was not conducted at 5000 hours and the fan continued to be operated and it exceeded the hours recommended for inspection. The C-check was later conducted at 9330.5 hours after which the fan was operated until its failure at 12 619.08 hours.

Probable Cause

In-flight smoke in the cockpit during the climb which originated from the fan's burnt driver card/control board and power board Number 1 recirculation fan. The recirculation fan also had loose, worn out ball bearing and dirt. The scorching of the fan was attributed to lack of maintenance.

Contributory Factor

Non-adherence to maintenance schedule as recommended by the manufacturer.

SRP Date	11 March 2025	Publication Date	19 March 2025
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Occurrence Details

Reference Number : CA18/3/2/1454
Occurrence Category : Category 2 (Serious Incident)
Type of Operation : Air Transport Operation, Passenger (Part 121)
Name of Operator : Airlink
Aircraft Make and Model : Embraer ERJ-135LR
Nationality : South African
Registration : ZS-OUV
Place : Overhead Potchefstroom, North West Province
Date and Time : 22 August 2024 at 1445Z
Injuries : None
Damage : None

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 22 August 2024 at 1530Z. The occurrence was classified as a serious incident according to the CAR 2011 Part 12 and the International Civil Aviation Organisation (ICAO) STD Annex 13 definitions. The notifications were sent to the State of Registry, Operator, Design and Manufacturer in accordance with the CAR 2011 Part 12 and the ICAO Annex 13 Chapter 4. The States did not appoint an accredited representative and/or advisor. The investigator did not dispatch to the incident site for this serious incident.

Notes:

- Whenever the following words are mentioned in this report, they shall mean the following:
Serious Incident — this investigated serious incident
Aircraft — the Embraer ERJ-135LR 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*
- 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

This report is produced without prejudice to the rights of the AIID, which are reserved.

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Abbreviation	Description
°	Degrees
°C	Degrees Celsius
AIID	Accident and Incident Investigations Division
AME	Aircraft Maintenance Engineer
AMM	Aircraft Maintenance Manual
AMO	Aircraft Maintenance Organisation
ARFF	Aircraft Rescue and Firefighting
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence
CAR	Civil Aviation Regulations
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CRS	Certificate of Release to Service
CVR	Cockpit Voice Recorder
EMRO	Enterprise Maintenance, Repair and Overhaul
FAOR	O.R. Tambo International Aerodrome (ICAO designation)
FASS	Sishen Aerodrome (ICAO designation)
FDR	Flight Data Recorder
FL	Flight Level
Ft	Feet
GPS	Global Positioning System
hPa	Hectopascal
Kg	Kilogram/s
kt	Knots
M	Metres
METAR	Meteorological Aerodrome Report
MTOW	Maximum Take-off Weight
NSC	No Significant Clouds
OEM	Original Equipment Manufacturer
PF	Pilot Flying
PIC	Pilot-in-command
PM	Pilot Monitoring
PSI	Pounds per Square Inch
QNH	Barometric Pressure Adjusted to Sea Level
QRH	Quick Reference Handbook
SACAA	South African Civil Aviation Authority
SAWS	South African Weather Service
UTC	Universal Co-ordinated Time (GMT)
Z	Zulu (Term for Universal Co-ordinated Time - Zero Hours Greenwich)

1. FACTUAL INFORMATION

1.1. History of Flight

1.1.1. On Thursday afternoon, 22 August 2024, the crew members (comprising two pilots and one flight attendant), and 14 passengers were on-board an Embraer ERJ-135LR aircraft with registration ZS-OUV when the serious incident occurred. This was a scheduled commercial passenger flight number 4Z779 from O.R. Tambo International Aerodrome (FAOR) in Gauteng province to Sishen Airport (FASS) in Northern Cape province. The flight was conducted under instrument flight rules (IFR) by day and under the provisions of Part 121 of the Civil Aviation Regulations (CAR) 2011 as amended.

1.1.2. The captain, who was the pilot flying (PF), stated that the aircraft departed from FAOR at 1354Z. Whilst overhead Potchefstroom in North West province and climbing through 24 500 feet (ft) above mean sea level (AMSL) to the intended 33 000ft as per the flight plan, the crew noticed a burning smell in the cockpit and, after a few minutes, observed white smoke emanating from the Number 1 gasper vent.



Figure 1: The Embraer 135LR gasper vent. (Source: Operator)

1.1.3. Thereafter, the crew donned their oxygen masks. The captain called the flight attendant via the intercom to check for smoke or fire in the cabin. After checking, the flight attendant reported no sign of smoke or fire in the cabin. The first officer (FO) who was the pilot monitoring (PM) notified the FAOR air traffic control (ATC) about the smoke in the cockpit on very high frequency (VHF) 118.10-Megahertz (MHz) and requested to level off the aircraft at 24 600ft. The FO's request was granted, and the aircraft levelled off at 24 600ft. The crew then referenced the aircraft's Quick Reference Handbook (QRH) under 'Cockpit/Cabin Smoke/Fumes' to follow the prescribed procedure. The recirculation fan was switched off and the smoke dissipated.

- 1.1.4. Thereafter, the FO declared an emergency by broadcasting a “PAN PAN PAN” to FAOR ATC. The captain piloted the aircraft back to FAOR. Approximately 51 minutes after the initial take-off, the aircraft landed safely on Runway 21L. The Airport Rescue and Firefighting (ARFF) personnel at FAOR were on standby when the aircraft landed. The ARFF personnel inspected the aircraft for signs of external damage, and none was found. The crew and the passengers were unharmed. The passengers disembarked from the aircraft and were transported to the terminal building. Later, they boarded another aircraft with a different crew to their destination.
- 1.1.5. The flight attendant stated that whilst the aircraft was in the climb phase with the seatbelt sign off, the interphone rang and the red emergency indicator light illuminated. Upon answering the call, the captain asked if she could identify smoke or a burning smell in the cabin. The flight attendant inspected the cabin and lavatory areas but found nothing abnormal. Following an inspection and assessment conducted by the cabin crew and based on the feedback from the flight attendant, the cabin crew members confirmed that the smoke and fumes were confined to the flight deck, with no evidence of smoke and fumes spreading to the passenger cabin.
- 1.1.6. The captain informed the cabin crew members that they were returning to FAOR due to a technical issue and that safety of all the occupants was his priority. The cabin crew acknowledged the captain’s instructions and subsequently secured the cabin as directed.
- 1.1.7. The crew members confirmed that the smoke and fumes were limited to the flight deck and had not spread to the cabin area.
- 1.1.8. The serious incident occurred during daytime at Global Positioning System (GPS) co-ordinates determined to be 26° 51'63" South (S) 027°25.23' East (E) whilst flying through 24 500 feet (ft).

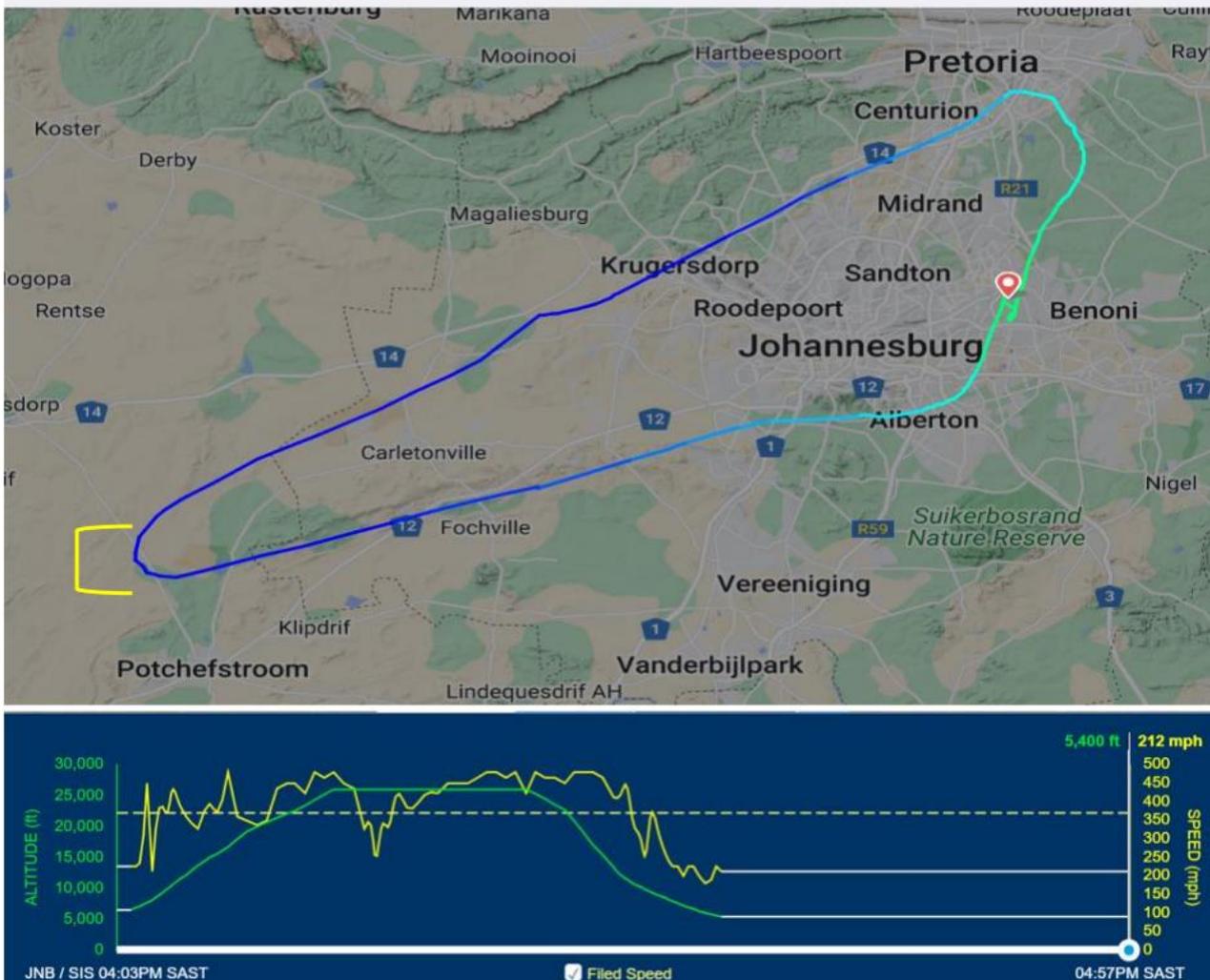


Figure 2: The aircraft’s flight path and an air turn back to FAOR. The yellow mark on the map indicates the point at which the crew initiated the air turnback. (Source: Flight Aware)

1.2. Injuries to Persons

Injuries	Pilot	Crew	Pass.	Total On-board	Other
Fatal	-	-	-	-	-
Serious	-	-	-	-	-
Minor	-	-	-	-	-
None	2	1	14	17	-
Total	2	1	14	17	-

Note: Other means people on the ground.

1.3. Damage to Aircraft

1.3.1. The Number 1 recirculation fan’s burnt driver card/control board and power board.

1.4. Other Damage

1.4.1. None.

1.5. Personnel Information

Pilot-in-Command (PIC)

Nationality	South African	Gender	Male	Age	31
Licence Type	Airline Transport Pilot Licence (ATPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instrument Rating				
Medical Expiry Date	31 March 2025				
Restrictions	VML, Corrective Lense to wear				
Previous Incidents	None.				

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

Flying Experience:

Total Hours	4 182.3
Total Past 24 Hours	4.5
Total Past 7 Days	14.5
Total Past 90 Days	215.4
Total on Type Past 90 Days	215.4
Total on Type	1 257.8

1.5.1. The PIC was initially issued an Airline Transport Pilot Licence (ATPL) on 24 November 2020 under the provisions of Part 61 of the CAR 2011. The licence was revalidated on 12 April 2024 with an expiry date of 30 April 2025.

1.5.2. The PIC was issued a Class 1 medical certificate on 24 March 2024 with an expiry date of 31 March 2025.

First Officer (Pilot Monitoring)

Nationality	South African	Gender	Female	Age	32
Licence Type	Airline Transport Pilot Licence (ATPL)				
Licence Valid	Yes	Type Endorsed	Yes		
Ratings	Instruments and Flight Instructor Grade II				
Medical Expiry Date	31 March 2025				
Restrictions	VML, Corrective Lenses				
Previous Accidents	None.				

Total Hours	4 182.3
Total Past 24 Hours	0
Total Past 7 Days	4.7
Total Past 90 Days	167.9
Total on Type Past 90 Days	167.9
Total on Type	800

- 1.5.3. The FO was initially issued an Airline Transport Pilot Licence (ATPL) on 8 November 2022 under the provisions of Part 61 of the CAR 2011. The licence was revalidated on 30 June 2024 with an expiry date of 30 June 2025.
- 1.5.4. The FO was issued a Class 1 medical certificate on 26 March 2024 with an expiry date of 31 March 2025.
- 1.5.5. The aircraft maintenance engineer (AME) who certified the last maintenance inspection prior to the accident flight had a valid AME Licence that was reissued on 23 June 2023 with an expiry date of 30 May 2025. The AME's licence had Embraer ERJ-135LR series endorsed on it.

1.6. Aircraft Information

1.6.1. Embraer 135LR (Source: www.skybrary.aero)

The Embraer ERJ-135LR is a long-range version of the original ERJ 135, featuring upgraded engines. It is a twin-engine regional jet produced by Embraer, a Brazilian aerospace company. The aircraft has a fixed-wing design with a low-wing configuration and is equipped with a tricycle undercarriage. The ERJ 135LR is typically configured with a 37-seat interior.



Figure 3: The file picture of the ZS-OUV aircraft.

(Source: <https://www.planespotters.net/photo/296749/zs-ouv-airlink-embraer-erj-135lr>)

Airframe:

Manufacturer/Model	Embraer / ERJ-135LR	
Serial Number	145493	
Year of Manufacture	2001	
Total Airframe Hours (At Time of Serious Incident)	44 805.15	
Last Inspection (Date & Hours)	21 June 2024	44 465.44
Airframe Hours Since Last Inspection	339.71	
CRS Issue Date	21 June 2024	

C of A (Issue Date & Expiry Date)	22 January 2008	31 January 2025
C of R (Issue Date) (Present Owner)	13 March 2018	
Operating Category	Air Transport Operation, Passenger (Part 121)	
Type of Fuel Used	Jet A1	
Previous Incidents	None.	

Note: Previous serious incidents refer to past serious incidents the aircraft was involved in, when relevant to this incident.

- 1.6.2. According to the aircraft maintenance manual (AMM), the recirculation fan is a component that is subject to wear and tear over time due to continuous operation, exposure to environmental factors and mechanical stresses. As a result, it requires regular inspection, maintenance, and potential replacement to ensure optimal performance and prevent failures that could impact cabin air circulation and overall aircraft safety.
- 1.6.3. The investigation reviewed the replacement history of the component over the past five years. It was observed that most previous failures did not result in smoke emission. The system is protected by a fuse designed to disconnect the power source from the pump when excessive current is drawn. The fuse was found unserviceable and was replaced with a serviceable one.
- 1.6.4. Enterprise Maintenance, Repair and Overhaul (EMRO) records indicated that the defective fan, installed in the wing, had been in operation since 5 August 2016 with 31 889:07 hours (after shop repair) in operation. According to the (AMM), the recirculation fan must be inspected during the C-Check every 30 months or at 5000 flight hours (FH), whichever comes first. The last inspection was conducted on 13 October 2022; however, this was not in compliance with the original equipment manufacturer's (OEM's) prescribed limits, as the recirculation fan had already accumulated 9 330.5 flight hours at that time (13 October 2022). At the time of failure on 22 August 2024, the fan had accumulated 44 508:15 hours. The fan's total in-service hours after its installation on ZS-OUV aircraft were 12 619.08.
- 1.6.5. The defective recirculation fan was replaced, and ground runs were conducted with the packs in operation with no further issues. The aircraft has since returned to service with no additional reports related to this defect.
- 1.6.6. Description and Operation of the Recirculation Fan
(Source: EMB135 Aircraft Maintenance Manual)

The gasper system receives air from the main distribution ducts or from the recirculation fan and distributes this air for ventilation of the cockpit, passenger cabin, lavatory, rear electronic compartment, oxygen cylinder compartment, and relay boxes.

The recirculation system has two fans operated by one switch installed on the AIR CONDITIONING/PNEUMATIC control panel. The recirculation fans supply air to the ECU

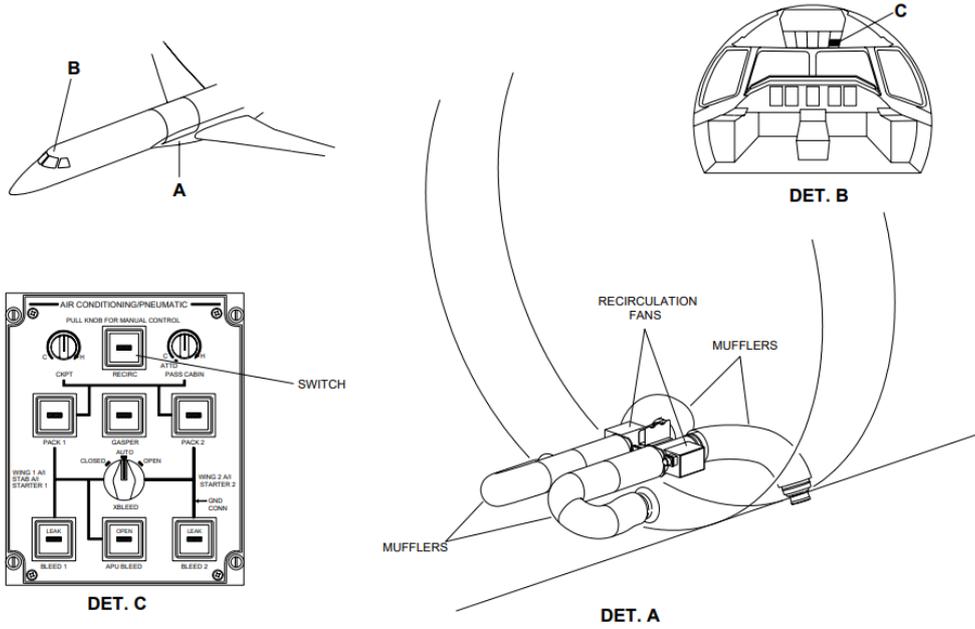
(Environmental Control Unit) outlets. (POST-MOD SB 145-21-0057) The recirculation air filters are HEPA (High-Efficiency Particulate Air) type filters configuration that filter particles before they get to the recirculation fans. The HEPA filters provide microbial filtration of the recirculation fans air to reduce pollution and infectious microorganisms, removing 99.999% of the bacteria and viruses.

The two fans of the recirculation system supply cabin air to mix with the turbine exhaust air in a condenser/mixer. This permits a high percentage of moisture to collect and prevents the condenser face from freezing. The use of the recirculation fans permits a decreased use of bleed air. The main components of the system are: – Recirculation fans. – (POST-MOD SB 145-21-0057) Recirculation air filters. – Mufflers. – Thermal switches. – Recirculation control switch



Figure 4: Sample of a recirculation fan from an Embraer aircraft. (Source: Scanparts.com)

The sketched illustration below (Recirculation System - Main Component Locations) shows the location of the main components of the system.



RECIRCULATION SYSTEM - MAIN COMPONENT LOCATIONS, Sheet 1

EMB-145 - SDS 1232

21-24-00

145AMM210320.MCE

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EMERGENCY/ABNORMAL PROCEDURES
Smoke

SMOKE EVACUATION

Condition: Smoke or odor inside the cabin and/or cockpit requiring smoke removal.

Crew Oxygen MasksDON, 100%
Smoke Goggles.....DON
Crew Communication....ESTABLISH

LAND AT THE NEAREST SUITABLE AIRPORT.

Cockpit Door CLOSE
Reinforced Cockpit Door Louver Vent (if applicable) CLOSE
Recirculation Fan..... PUSH OUT
Gasper Fan PUSH OUT
Pressurization Manual Controller 1 O'CLOCK POSITION

 WAIT 15 SECONDS

Pressurization Mode Selector PUSH IN (MAN)
Passenger Oxygen AS REQUIRED

CONTINUES ON NEXT PAGE

EMERGENCY/ABNORMAL PROCEDURES
Smoke

CONTINUED FROM PREVIOUS PAGE

DESIRED EVACUATION RATE? Fast

↓ Normal

Pressurization Manual Controller AS REQUIRED
Turn the controller clockwise towards UP to adjust desired evacuation rate.

END

↓

Pressurization Manual Controller UP
Packs 1 and 2 PUSH OUT
Bleeds (at least one).... PUSH IN
Altitude 10'000 FT OR MEA, WHICHEVER IS HIGHER

Recover cabin pressure as soon as smoke has been cleared.
EMERGENCY DESCENT Procedure (NAP-6).... AS REQUIRED

END

S-4 REVISION 16

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S-5 REVISION 16

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Engine 1:

Manufacturer/Model	Rolls Royce / AE3007
Serial Number	CAE312124
Part Number	23070402
Hours Since New	37 150:54
Hours Since Overhaul	Modular o/Haul via Hot section inspections at approved intervals

Engine 2:

Manufacturer/Model	Rolls Royce / AE3007
Serial Number	CAE312178
Part Number	23070407
Hours Since New	37 990:35
Hours Since Overhaul	Modular o/Haul via hot section inspections at approved intervals

1.7. Meteorological Information

1.7.1. The weather information at FL245 entered in the table below was sourced from the Meteorological Aerodrome Report (METAR) that was issued by the South African Weather Service (SAWS) on 22 August 2024 at 0445Z.

Wind Direction	230°	Wind Speed	04kt	Visibility	9999m
Temperature	24°C	Cloud Cover	Nil	Cloud Base	Nil
Dew Point	-11°C	QNH	1026hPa		

1.8. Aids to Navigation

1.8.1. The aircraft was equipped with standard navigational equipment as approved by the Regulator. 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 a standard communication system as approved by the Regulator. There were no recorded defects with the communication system before the serious incident.

1.10. Aerodrome Information

1.10.1. The aircraft landed at FAOR on Runway 21L.

Aerodrome Name	O.R. Tambo International Aerodrome (FAOR)
Aerodrome Location	Gauteng Province
Aerodrome Status	Licensed
Aerodrome GPS coordinates	26°08'.00" South, 028°14'.05" East
Aerodrome Elevation	5 558ft
Runway Headings	03L/21R, 03R/21L
Dimensions of Runway Used	4 421m x 60m, 3 405m x 60m
Heading of Runway Used	3L/21R,
Surface of Runway Used	Asphalt
Approach Facilities	DVOR/DME, ILS LOC, ILS GP, Runway lights, PAPI's
Radio Frequency	ATIS: 126.20, 115.20 Apron: 122.65 Tower East: 118.60 Tower West: 118.10 Approach South: 124.50 Approach East: 124.50 Approach West: 123.70 SMC: 121.9

1.11. Flight Recorders

1.11.1. The aircraft was equipped with a flight data recorder (FDR) and a cockpit voice recorder (CVR) as required by Part 121.05 of the CAR 2011 as amended.

1.12. Wreckage and Impact Information

1.12.1. Not applicable.

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 accident was considered survivable as the aircraft made a safe landing and had no damage to the structure.

1.16. Tests and Research

(a) The recirculation fan with part number 4611028900 and serial number 1501 was removed from the aircraft and sent to the manufacturer to determine (i) the most probable causal factor/s regarding the smoke that emanated from the cockpit during operation.

1.16.1. Visual Inspection Results:

- (i) The ball bearing was found to be loose and worn out.
- (ii) Strong dirt contamination
- (iii) The Driver Card/Control Board was found burnt
- (iv) The Power Board was found burnt.

1.17. Organisational and Management Information

1.17.1. This was a scheduled passenger commercial flight operated under the provisions of Part 121 of the CAR 2011 as amended.

1.17.2. The operator was issued a Class I Air Service Domestic Licence by the Air Service Licensing Council on 23 February 2005 for Category A1, A2 and A3 aircraft. The operator was also issued a Class II Air Service Domestic Licence on 24 January 2018 for Category A1, A2, A3, A4 and H2 aircraft.

1.17.3. The operator had a valid Air Operating Certificate (AOC) that was issued by the Regulator on 23 April 2024 with an expiry date of 30 April 2025.

1.17.4. The aircraft was maintained by the SACAA-approved aircraft maintenance organisation (AMO). The AMO was issued an AMO Certificate on 30 April 2024 with an expiry date of 30 April 2025.

1.18. Additional Information

1.18.1. None.

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

Pilots

2.2.1. The flight crew's licences and medical certificates were valid, and they met all regulatory requirements for operating the aircraft, including type endorsements and medical fitness. The pilots were well rested.

2.2.2. At the time of the smoke in the cockpit, the captain was the pilot flying (PF), and the first officer was the pilot monitoring (PM). The crew declared an emergency, followed the Quick Reference Handbook (QRH) procedures, switched off the recirculation fan, and the smoke dissipated. Thereafter, they returned to FAOR.

2.2.3. The aircraft maintenance engineer had a valid licence and met all regulatory requirements to conduct maintenance on the aircraft.

Mission

2.2.4. This was an air transport operation passenger flight conducted under the provisions of Part 121 of the CAR 2011 as amended. The operator had valid certificates to operate and maintain the aircraft.

Machine

2.2.5. The aircraft was registered to the present owner since 13 March 2018. The recent inspection and the Certificate of Release to Service (CRS) were conducted in compliance with the regulations. The aircraft was deemed airworthy when it was dispatched for the flight although the fan maintenance was not conducted during the previous C-check inspection.

2.2.6. The investigation determined that the fan was required to be inspected every 5 000 hours, but this inspection was not performed when it was due. At the time of the last C-check inspection, the fan had accumulated 9 330.5 hours. As a result, the aircraft was not correctly certified and released.

The recirculation fan is a component subject to wear and tear over time, requiring regular inspections and maintenance to ensure aircraft safety. The following are the most likely causes of the incident as identified by the OEM.

- (i) The ball bearing was found to be loose and worn out
- (ii) Strong Dirt Contamination
- (iii) The Driver Card/Control Board was found burnt
- (iv) The Power Board was found burnt

2.2.7. However, it is most likely that the smoke in the cockpit was caused by scorching of the drive card/control board and power board, as well as the loose, worn-out ball bearing and dirt found in the fan.

Weather

2.2.8. Fine weather conditions prevailed at the time of the flight; 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 serious 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 serious incident. The findings are significant steps in this serious 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 serious 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 serious incident occurring, or would have mitigated the severity of the consequences of the serious 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

Pilots

- 3.2.1. The PIC was initially issued an Airline Transport Pilot Licence (ATPL) on 24 November 2020 under the provisions of Part 61 of the CAR 2011. The licence was revalidated on 12 April 2024 with an expiry date of 30 April 2025. The PIC was properly certified for this flight and had the necessary knowledge and experience.
- 3.2.2. The PIC was issued a Class 1 medical certificate on 29 September 2023 with an expiry date of 30 March 2024.
- 3.2.3. The first officer (FO) was initially issued an Airline Transport Pilot Licence (ATPL) on 8 November 2022 under the provisions of Part 61 of the CAR 2011. The licence was revalidated on 30 June 2024 with an expiry date of 30 June 2025. The FO had the instrument and instructor Grade 2 ratings. The FO was properly certified for this flight and had the necessary knowledge and experience.
- 3.2.4. The FO was issued a Class 1 aviation medical certificate on 26 March 2024 with an expiry date of 31 March 2025.
- 3.2.5. The FO declared an emergency by broadcasting a “PAN PAN PAN” to the FAOR ATC informing them of the smoke in the cockpit.

Aircraft

- 3.2.6. The aircraft was issued a Certificate of Registration on 13 March 2018.
- 3.2.7. The last maintenance inspection (A-Check) that was conducted on the aircraft before the serious incident flight was certified on 21 June 2024 at 44 465.44 airframe hours. The aircraft had accrued 339.71 airframe hours since the said inspection.
- 3.2.8. The aircraft was issued a Certificate of Airworthiness (C of A) on 22 January 2008. The latest C of A had an expiry date of 31 January 2025.

3.2.9. The aircraft was issued a Certificate of Release to Service (CRS) on 21 June 2024 at 44 465.44 airframe hours with an expiry date of 12 January 2025 or at 44 960.10 airframe hours, whichever occurs first. There were no defects recorded in the flight folio at the time of the flight. The aircraft was airworthy before the serious incident.

3.2.10. The recirculation fan is a component that experiences wear and tear over time, necessitating regular inspections and maintenance to ensure the safety of the aircraft.

3.2.11. The OEM's report suggested that the likely causes of the smoke in the cockpit were as follows.

- (i) The ball bearing was found to be loose and worn out
- (ii) Strong Dirt Contamination
- (iii) The Driver Card/Control Board was found burnt
- (iv) The Power Board was found burnt

3.2.12. The investigator's opinion is that the most likely causes of the smoke on the cockpit could be attributed to the scorching of the drive card/control board and the power board. The investigation determined that the fan was required to be inspected every 5000 hours, but this inspection was not performed when it was due. At the time of the last C-check inspection, the fan had accumulated 9 330.5 hours. As a result, the aircraft was not correctly certified and released.

Environment

3.2.13. Fine weather conditions prevailed at the time of the flight; the weather conditions had no bearing on this serious incident.

Aerodrome

3.2.14. FAOR is a licensed aerodrome with two parallel runways. The aircraft used Runway 21R for take-off, which is 4 421m long and 60m wide. On their return, the aircraft landed on Runway 21L.

3.3. Probable Cause

3.3.1. In-flight smoke in the cockpit during the climb which originated from the fan's burnt driver card/control board and power board Number 1 recirculating fan. The recirculation fan also had loose, worn out ball bearing and dirt. The scorching of the fan was attributed to the lack of maintenance.

3.4. Contributory Factor/s

3.4.1. Non-adherence to maintenance schedule as recommended by the manufacturer.

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 Message

4.2.1. The operator's fleet of Embraer 135 aircraft should be reviewed for compliance.

5. APPENDICES

5.1. Appendix A: FAOR layout chart

This report is issued by:

**Accident and Incident Investigations Division
South African Civil Aviation Authority
Republic of South Africa**

