



AIRCRAFT ACCIDENT REPORT

APL//2019/11/05/F

Nigerian Safety Investigation Bureau

Final Report on the Incident involving a Boeing 737-500 aircraft with nationality and registration marks 5N-BUJ Operated by Air Peace Limited, which occurred at FL230 en-route Sam Mbakwe Airport, Owerri; Nigeria on 5 November 2019.



This report is produced by the Nigerian Safety Investigation Bureau, (NSIB) formerly the Accident Investigation Bureau, Nigeria (AIB), Nnamdi Azikiwe International Airport, Abuja.

The report is based on the investigation carried out by Nigerian Safety Investigation Bureau, in accordance with Annex 13 to the Convention on International Civil Aviation, Nigerian Safety Investigation Bureau (Establishment) Act, 2022, and Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2023.

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GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AGL	Above Ground Level
AMM	Aircraft Maintenance Manual
AMSL	Above Mean Sea Level
APU	Auxiliary Power Unit
ATC	Air Traffic Control
ACC	Area Control Centre
ATPL	Airline Transport Pilot Licence
CVR	Cockpit Voice Recorder
CT	Control Tower
CRM	Crew Resource Management
DME	Distance Measuring Equipment
DNMM	ICAO designator for Murtala Muhammed Airport
DNPO	ICAO designator for Port Harcourt Airport
FDR	Flight Data Recorder
FL	Flight Level
fpm	feet per minute
IFR	Instrument Flight Rules
ILS	Instrument Landing System



IMC	Instrument Meteorological Conditions
N ₁ /N ₂	Rotational Speed for Engine Pressure Ratio (EPR) for each engine
nm	Nautical Miles
PIREP	Pilot Report
PF	Pilot Flying
PM	Pilot Monitoring
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Range, a short-range radio navigation system that helps pilots determine their position relative to ground stations.



5N-BUJ

Report number:	APL/2019/11/05/F
Operator:	Air Peace Limited
Aircraft type and model:	Boeing 737-500
Manufacturer:	The Boeing Company, USA
Year of manufacture:	1997
Serial number:	28721
Nationality and registration marks:	5N-BUJ
Location:	FL230 enroute Sam Mbakwe Airport, Owerri
Date and time:	5 November, 2019 at about 07:46 h

*(All times in this report are local time
(UTC+1) unless otherwise stated)*

SYNOPSIS

The Nigerian Safety Investigation Bureau (NSIB) was notified of the occurrence by the airline operator on 5 November, 2019. Investigators were dispatched the same day to the General Aviation Terminal (GAT) of the Murtala Muhammed Airport, Lagos, where the aircraft was parked on the apron, to commence post occurrence assessment under the provisions of Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019 and Annex 13 to the Convention on International Civil Aviation. All relevant stakeholders were notified.

On 5 November 2019, about 07:35 h; a Boeing 737-500 aircraft with nationality and registration marks 5N-BUJ, operated by Air Peace Limited as a scheduled passenger flight APK7004 departed Murtala Muhammed International Airport (DNMM), Lagos for Sam



Mbakwe Airport (DNIM), Owerri with 90 persons on board, including six crew members. The First Officer was the Pilot Flying (PF) while the Captain was the Pilot Monitoring (PM).

At 07:40:16 h, the aircraft was in contact with the Lagos Area Control Centre (ACC) which cleared it to climb to FL310 and to proceed direct ARAGU¹.

According to the First Officer, at about FL230, a loud bang was heard, Autopilot disengaged and the aircraft veered to the right. A second bang was heard a few seconds thereafter, following which the flight crew reported a rapid decrease in rotation speed of the low pressure spool (N_1) of Engine No.2.

The Captain took control of the aircraft and started the APU. At 07:46:32h, the crew declared 'MAYDAY' (emergency) to ACC, requesting to stop climbing and divert back to Lagos, which was granted. At 08:06:47h, APK7004 landed safely on runway 18R and taxied on its own power to the General Aviation Terminal (GAT) apron where, it parked and passengers disembarked normally without injury.

The Incident occurred in daylight and Visual Meteorological Conditions prevailed.

Causal factor

The failure of No. 3 main line bearing in the front modules of Engine No.2.

¹A reporting point



1.0 FACTUAL INFORMATION

1.1 History of the flight

On 5 November 2019 at about 07:35 h, a Boeing 737-500 aircraft with nationality and registration marks 5N-BUJ operated by Air Peace Limited departed Murtala Muhammed International Airport Lagos (DNMM) as flight APK7004 for Sam Mbakwe Airport Owerri (DNIM). It was a scheduled flight on an Instrument Flight Rules (IFR) flight plan with 90 persons on board inclusive of six crew members. The First Officer was the Pilot Flying (PF) while the Captain was the Pilot Monitoring (PM).

The flight crew stated that they resumed duty at 06:00 h to operate the first sector of the day. They carried out the pre-flight inspection of the aircraft, reviewed the current destination weather report for Owerri and then called for boarding. Thereafter requested Engine Start-up Clearance which was granted by the ATC. Taxi clearance was thereafter requested and granted.

At 07:35:27 h, the APK7004 was airborne. At 07:40:16 h, the aircraft made contact with the Lagos Area Control Centre (ACC) and was cleared to climb to FL310 to proceed direct ARAGU².

According to the First Officer, who was the PF at the time, "At about 23,000 ft, I heard a loud bang and the automation went off and the airplane veered a little to the right. The second bang came few seconds after the first and we quickly glanced at the primary engine instrument panel and noticed that [right engine] N_2 ³ indication was zero; N_1 ⁴ was also rapidly decreasing and was at about 30% while we were Climbing".

The flight crew stated that this was identified as 'SEVERE ENGINE DAMAGE' and in

² ARAGU is a reporting point

³ N_2 - Rotational speed of the High Pressure Turbine and Compressor Spool expressed in % of the maximum normal operating RPM.

⁴ N_1 - Rotational speed of the Low Pressure Turbine and Compressor Spool expressed in % of the maximum normal operating RPM.



response, carried out memory items before consulting the B737 Quick Reference Handbook (QRH). The Captain took control of the aircraft and started the APU.

At 07:46:32 h, the crew declared 'MAYDAY' (emergency) to ACC, requesting to stop the Climb and to divert back to DNMM which was granted. The ACC cleared the aircraft to descend to FL220 and proceed to Lagos. The Captain briefed the passengers about the situation while the First Officer notified the OCC.

At 07:48:44 h, ACC further cleared the aircraft to descend to FL160, proceed direct to Lagos and to contact Approach Control. The crew acknowledged the clearance. At 07:49:57 h, when the aircraft was in contact with Lagos Approach Control, the crew downgraded the emergency declaration to a 'PAN PAN PAN'. They also requested to use runway 18R for landing.

At 07:50:15 h, Approach Control cleared the aircraft as follows: "APK7004 IDENTIFY AT 62 NMS. EAST LAG EXPECT RADAR VECTOR FOR RNAV APPROACH RUNWAY 18R OR VOR/DME APPROACH FOR RUNWAY 18R DESCEND FL 50". The crew responded as follows: "DESCENDING FL50 WE HAVE AN EMERGENCY WE CAN NOT DO A VOR APPROACH WE HAVE AN EMERGENCY WE LOST AN ENGINE WE CAN'T DO A VOR APPROACH".

Approach Control then cleared the aircraft to fly direct Lagos and further descended it to 2,200 ft before being transferred to the Lagos Control Tower at 8 nm to Touchdown. At 08:03:07 h, the aircraft made contact with Control Tower and was cleared to land.

At 08:06:47 h, the aircraft landed safely on runway 18R. It was escorted by the waiting emergency vehicles as it taxied on its own power to the General Aviation Terminal (GAT) apron where it parked and passengers disembarked normally without injury.

The incident occurred in daylight and Visual Meteorological Conditions prevailed.



1.2 Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil
None	6	84	90
Total	6	84	90

1.3 Damage to aircraft

The aircraft is slightly damaged

1.4 Other damage

Nil.

1.5 Personnel information

1.5.1 Captain

Nationality:	Nigerian
Age:	42 years
Licence type:	Airline Transport Pilot Licence (Aeroplane)
Licence:	Valid till 18th January, 2021
Ratings:	B737-300/500, Dash-8, CRJ-700/900, Dornier-328-300
Medical:	Valid till 5th March, 2020
Simulator:	Valid till 7th January, 2020



5N-BUJ

Total Flying Time:	8,900 h
Total on type:	4,000 h
Total on type (PIC):	4,000 h
Last 90 days:	90 h
Last 28 days:	40 h
Last 24 hours:	3:05 h

1.5.2 First officer

Nationality:	Nigerian
Age:	33 years
License type:	Airline Transport Pilot License (Aeroplane)
License:	Valid till 26 August, 2023
Aircraft ratings:	B737-300/500
Medical:	Valid till 15 August, 2020
Simulator:	Valid till 29 February, 2020
Total flying time:	3,353 h
Total on type:	3,047 h
Last 90 days:	84:25 h
Last 28 Days:	37:40 h
Last 24 Hours:	04:10 h



1.6 Aircraft information

1.6.1 General information

Type:	Boeing 737-5L9
Manufacturer:	The Boeing Company, USA
Operator:	Air Peace Limited
Airframe time:	41,792 h
Cycles since new:	30,978
Serial number:	28721
Year of manufacture:	1997
Certificate of airworthiness:	Valid till 5 August, 2020
Certificate of insurance:	Valid till 31 December, 2019
Certificate of registration:	Issued 1 August, 2016
Noise certificate:	Issued 1 August, 2016



Figure 1: The aircraft parked at G.A.T apron after the Air Return

1.6.2 Engines

Engines	Number 1	Number 2
Serial Number	858739	720461
Type	CFM 56-3C1	CFM 56-3B1
Manufacturer	CFM International, USA	CFM International, USA
Time Since New	39,553:23 h	84,197:20 h
Cycles Since New	30,611	77,223

On 22 June, 2018, the incident engine, S/N 720461 was removed from an aircraft in Air Peace Limited fleet, 5N-BQQ at Time Since New (TSN) of 83,611:31 h and Cycle Since New (CSN) of 76,567.

On 11 April, 2019, Authorised Release Certificate (EASA Form 1) was issued by Jordan Airmotive Limited Company in respect of a repair work done on the incident engine S/N 720461 at TSN of 83,611:31 h.

On 17 April, 2019, the repaired engine S/N 720461 was installed at the right (No. 2) position on 5N-BUJ at TSN of 83,611:31 h and CSN of 76,567 and the first flight with engine S/N 720461 was conducted on the same day.

On 19 October, 2019 a deferred defect on 'ENG. 2 EGT ERRATIC' was entered in the Deferred Defect Log book and action taken to clear the defect on 20 October, 2019 was 'ENG. 2 EGT Harness'.

The Engine No. 2 Limiter as at 4 November, 2019 was 4,359 cycles remaining. The Time Since Repair (TSR) and Cycles Since Repair (CSR) of Engine S/N 720461 at the time of the occurrence was 586.29 h and 655 cycles, respectively.

Metal debris were found around the tail cone of Engine No. 2 during post-occurrence inspection. See Figure 2 below.

Type of fuel used: Jet A1



Figure 2: Metal debris in the tail cone of No. 2 engine during post occurrence inspection



1.7 Meteorological information

The weather report for Lagos (DNMM) on the day of the occurrence obtained from the Nigerian Meteorological Agency (NiMET) is as follows:

Time	0600 UTC	0700 UTC
Wind	Calm	Variable at 02 kt
Visibility	10 km	7 km
Weather	Slight drizzle	Nil
Cloud	SCT 330 m, Few 600 m CB (NW-N	SCT 330 m, Few 600 m CB (NW-N
Temp/Dew point	27 °C/25 °C	27 °C/25 °C
QNH	1014 hPa	1014 hPa
Trend	NOSIG	NOSIG

1.8 Aids to navigation

Equipment status in Lagos where the aircraft took off and landed were as follows:

'LAG' VOR/DME	113.7 MHz		-Serviceable-
'ILA' ILS/DME	110.3 MHz	RWY 18L	- Serviceable-
'ILB' ILS/DME	108.1 MHz	RWY 18R	- Serviceable-

1.9 Communications

There was effective communication between the aircraft and various ATC units. The status of the equipment on the day of the occurrence was as follows:

Lagos Radar/Approach Control	VHF 124.7 MHz:	-Serviceable-
Lagos Area Control	VHF 127.3 MHz:	-Serviceable-
Lagos Tower Control	VHF 118.1 MHz:	-Serviceable-



1.10 Aerodrome information

Murtala Muhammed International Airport, Lagos was the departure airfield where the aircraft took off from, and landed after the air return.

The aerodrome has two parallel runways 18L/36R and 18R/36L serving the domestic and international wings of the airport respectively. The airport elevation is 135 ft and runway length of 18L/36R is 9,006 ft (2,745 m) while 18R/36L is 12,795 ft (3,900 m). The airport is rated CAT 9 in fire coverage capabilities.

1.11 Flight recorders

The aircraft is fitted with Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR) with the following details:

	Flight Data Recorder	Cockpit Voice Recorder
Manufacturer	Allied Signal	Fairchild
Model	SSFDR	A200S
Part Number	980-4700-003	S200-0012-00
Serial Number	6293	01002

Both recorders were retrieved in good condition and their data were downloaded successfully at the NSIB Flight Safety Laboratory (now Transportation Safety Laboratory).



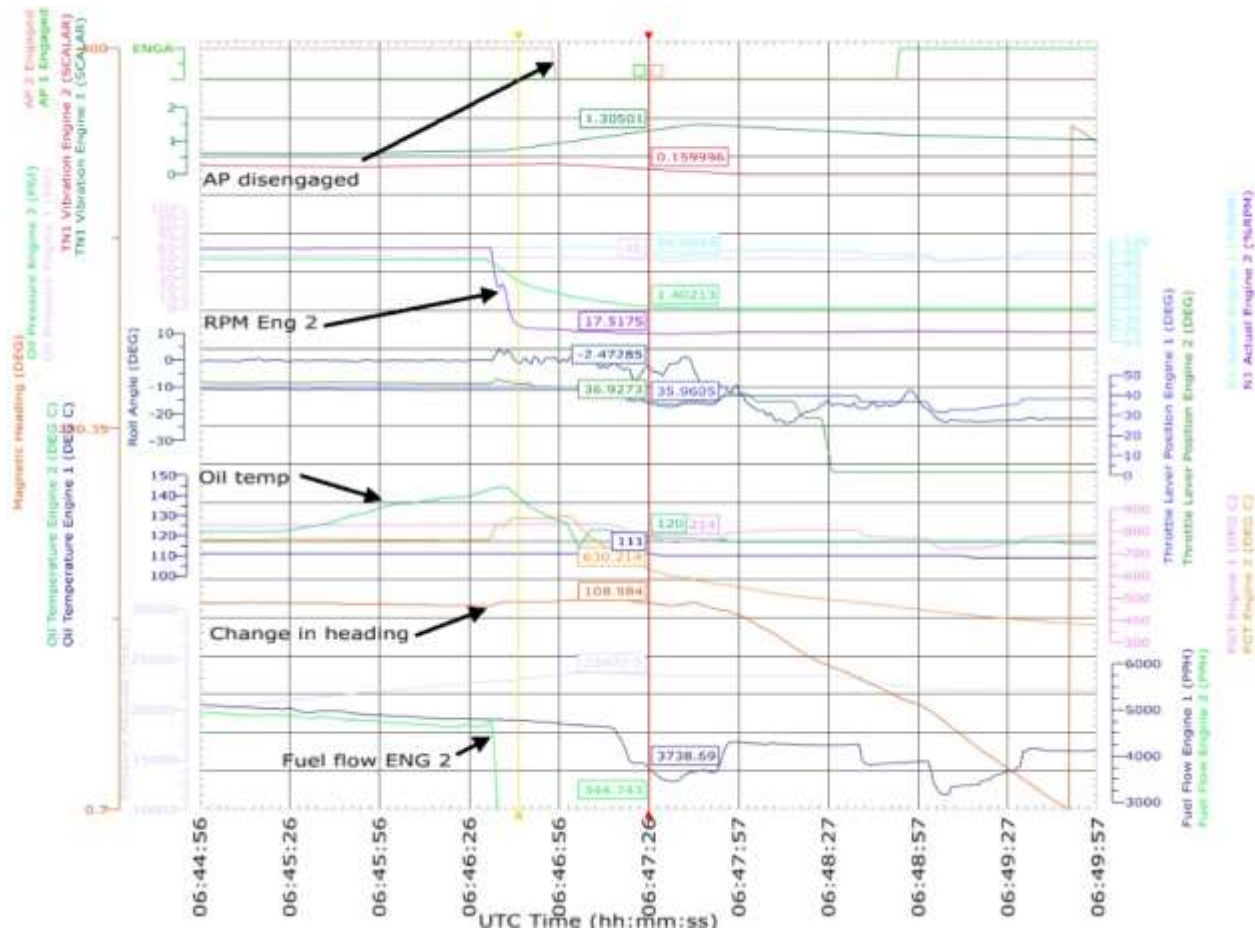


Figure 4: The FDR Plot 2

The FDR indicates that engine parameter activities were consistent with pre-take-off power checks before take-off.

At 06:45:26 UTC, Engine 2 oil temperature began rising from 122°C to a maximum value of 144°C, and about a minute later the exhaust gas temperature (EGT) from 761°C to 869°C. Simultaneously, the Engine 2 N1 speed began to decrease from 60% and remained stable at 17%.

The aircraft's magnetic heading started to change from 107° to 109° and the fuel flow to



Engine 2 dropped suddenly.

At 06:46:26 UTC, the autopilot (AP2) was disengaged. A slight increase in both Engine 1 and Engine 2 vibration was recorded just prior to 06:47:26 UTC.

By 06:47:27 UTC, the throttle lever angle for Engine 2 was indicating 0°.

At 06:46:35 UTC, at 22,187.3 ft (pressure altitude), there was a sudden decline in Engine Number 2 parameters (N_1 , N_2 , Fuel flow and EGT) while still Climbing.

The aircraft Climb was then halted, the associated Thrust Lever was retarded and a diversion back to aerodrome of departure was made. The aircraft touched down at 07:06:44 UTC.

1.12 Wreckage and impact information

Not applicable

1.13 Medical and pathological information

Nil.

1.14 Fire

There was no fire outbreak.



1.15 Survival aspects

The Incident was survivable due to the prompt situational awareness exhibited by the flight crew in identifying the loud sound as 'severe engine damage', the decision to divert back to the departure aerodrome, Lagos, and landing on a longer runway 18R with adequate landing aids and facilities.

1.16 Test and research

1.16.1 Engine tear down

The damaged CFM 56-3B1 Engine No. 2 with serial number 720461 was shipped to the facility of Jordan Airmotive Limited Company at Queen Alia International Airport – Free Zone, Amman – Jordan. The shipment arrived on 29 January, 2020 and was quarantined as instructed by the operator, Air Peace Limited. The engine teardown started on 1 August, 2021 after it was delayed due to lockdown occasioned by COVID-19 pandemic with the attendant travel restrictions. The teardown was completed on 11 August, 2021. Nigeria Safety Investigation Bureau (NSIB) delegated Jordan Civil Aviation Regulatory Commission to be present during the exercise.

1.16.2 Conclusion of the teardown report

Referring to above inspection results, no signs for any FOD, engine entrance from fan blades up to booster blades are not damaged, the damage just started from No.3 bearing, all five main line bearing (#01 to #05) in good condition except the No.3 bearing found completely damaged.

From all inspection results and above situation of engine front modules, the only reason for engine damage and IFSD situation is the failure of No.3 bearing.



1.17 Organizational and management information

1.17.1 Air Peace Limited

Air Peace is a Nigeria commercial airline founded in 2013 with Head Office in Lagos State, Nigeria. Her Main Operating Base is located at Murtala Muhammed International Airport, Lagos. Air Peace provides commercial, charter flights, and serves the major cities of Nigeria. It also operates to International destinations, including countries in West Africa and the Middle East.

At the time of the occurrence, Air Peace Limited held an Air Operator Certificate (AOC) Number APL/AOC/09-14/01, valid from 8th September 2018 to 7th September 2020. There are a total of 25 aircraft in her fleet, including 13 B737, 3 B777, 1 Dornier Do-328JET, and 8 EMB ERJ-145. Air Peace has the following Designations: P4 (IATA), APK (ICAO) and PEACE BIRD (Call sign).

1.17.2 Jordan Airmotive Limited Company

Jordan Airmotive Company (sometimes referred to as JALCo), the legal successor of Royal Jordanian (RJ) Airlines (the National carrier of Jordan) is an engine overhaul facility, which was established in 1985. The aim and purpose behind its creation then was to support the Royal Jordanian airline fleet in terms of maintenance and overhaul requirements for the JT8D series, JT3D & RB211-524 series engines. The last engine shop visit by the airline was at JALCo and the teardown exercise was also carried out at the facility.

The company has full capabilities for the following engines:

- a) CF6-80C2
- b) CFM56-3
- c) CFM56-5B



In the year 2006, Jordan Airmotive became a totally private company, and the 27,000 sqm facility emerged to take its place on the MRO world map, with a revived capability and ratings to include GE CF6-80C2 series (fitted on A300, A310, B747, B767), CFMI CFM56-3 series (fitted on B737 Classic) and CFM56-5B (fitted on A318, A319, A320 and A321).

1.18 Additional Information

Not applicable.

1.19 Useful or effective investigation techniques

Not applicable.



2.0 ANALYSIS

2.1 General

The flight crew were certified and qualified to conduct the flight in accordance with the provisions of the Nigeria Civil Aviation Regulations (Nig. CARs). The aircraft had a valid Certificate of Airworthiness (C of A) at the time of this occurrence; the weight and balance were within specification. The analysis focuses on the Engine number 2 failure and Engine number 2 maintenance history.

2.2 Engine number 2 failure

At about FL230 into the flight, a loud bang was heard and the aircraft veered a little to the right. Few seconds after another bang was heard and the flight crew observed from the primary engine instrument panel and noticed that [right engine] N_2^5 indication was zero; N_1^6 was also rapidly decreasing and was at about 30%.

The initial indication of the abnormal condition was a rise in Engine 2 oil temperature, increasing from 122°C to a peak of 144°C. This significant increase suggested a possible failure within the engine's lubrication system

Approximately one minute later, a sharp increase in Engine 2 Exhaust Gas Temperature (EGT) was recorded, rising from 761°C to 869°C. This coincided with a rapid reduction in Engine 2 N1 speed, dropping from 60% to 17%, which suggests that the engine was no longer producing normal thrust. The combination of high oil temperature and rising EGT is typically associated with internal engine damage or failure of one or more rotating assemblies.

⁵ N_2 - Rotational speed of the High Pressure Turbine and Compressor Spool expressed in % of the maximum normal operating RPM.

⁶ N_1 - Rotational speed of the Low Pressure Turbine and Compressor Spool expressed in % of the maximum normal operating RPM.



The crew's action to reduce Engine 2 throttle to 0° and disengage the autopilot indicates an appropriate response to a non-normal condition, in line with the QRH guidance for an engine malfunction or failure in flight.

The data supports the conclusion that Engine 2 experienced a progressive failure, beginning with oil temperature rise, followed by excessive EGT, loss of N1 speed, and vibration increase. The cause is likely attributable to internal mechanical or lubrication system failure, which led to pilot-initiated engine shutdown. The aircraft remained under control, and there was no evidence of immediate escalation into an unsafe condition.

2.3 Engine number 2 maintenance history

On 22 June, 2018, the incident engine, S/N 720461 was removed from an aircraft in Air Peace Limited fleet, 5N-BQQ with Time Since New (TSN) of 83,611:31 h and Cycle Since New (CSN) of 76,567.

On 11 April, 2019, Authorised Release Certificate (EASA Form 1) was issued by Jordan Airmotive Limited Company in respect of a repair work done on the incident engine S/N 720461 with TSN of 83,611:31 h.

On 17 April, 2019, the repaired engine, S/N 720461 was installed at the right (No. 2) position on 5N-BUJ with TSN of 83,611:31 h and CSN of 76,567.

On 17 June, 2019, the first flight with engine S/N 720461 was conducted.

During the last shop visit, the Operator requested the Jordan Airmotive Limited Company to perform the following tasks on the incident engine:

- a. Fan Major module: Minimum work scope
- b. Core Major module: Performance work scope



c. LPT Major module: Repair work scope

The investigation revealed the job description on the engine as Core Performance Restoration and LLPs (Life Limited Parts) replacement.

However, no task was performed on main line bearings as evident in the task cards because such maintenance was not part of the work scope given to the MRO.



3.0 CONCLUSIONS

3.1 Findings

1. The flight crew were qualified and licensed to fly the aircraft.
2. The First Officer was the Pilot Flying (PF) and the Captain was the Pilot Monitoring (PM).
3. The Captain took control of the aircraft at FL230 after the loud bang.
4. The aircraft had a valid Certificate of Airworthiness.
5. On 22 June, 2018, the incident engine, S/N720461 was removed from an aircraft in Air Peace Limited fleet, 5N-BQQ at Time Since New (TSN) of 83,611:31 hours and Cycles Since New (CSN) of 76,567 cycles.
6. On 11 April, 2019, Authorised Release Certificate (EASA Form 1) was issued by Jordan Airmotive Limited Company in respect of a repair work done on the incident engine, S/N 720461 at TSN of 83,611:31 hours.
7. On 17 April, 2019, the repaired engine, S/N720461 was installed at the Right Hand (No. 2) position on 5N-BUJ at TSN of 83,611:31 hours and CSN of 76,567 cycles.
8. On 17 June, 2019, the first flight with the repaired engine installed on 5N-BUJ was conducted.
9. On 19 October, 2019 a deferred defect on 'ENG. 2 EGT ERRATIC' was entered in the Deferred Defect Logbook and action taken to clear the defect on 20th October, 2019 was 'ENG. 2 EGT Harness'.
10. The Engine No. 2 Limiter as at 4 November, 2019 was 4,359 cycles.
11. On 5 November, 2019, at TSN of 84,197:6 hours and CSN of 77,222 cycles, the N₁ and N₂ gauges of Engine No. 2 S/N 720461 indicated below normal values in flight from Lagos enroute Owerri at about FL230.
12. Metal debris were found at the tail cone of Engine No. 2 during post-occurrence inspection.
13. The Time Since Repair (TSR) and Cycles Since Repair (CSR) of Engine S/N720461



was 586.29 hours and 655 cycles, respectively at the time of the occurrence.

14. At 07:46:32 h, the crew made a 'MAYDAY' (Emergency) call to ATC.
15. At 07:49:57 h, the crew declared 'PAN PAN PAN' to Approach Control and requested runway 18R for landing.
16. At 08:06:47 h, the aircraft landed safely on runway 18R.
17. The crew and passengers disembarked normally without any injury.
18. Post occurrence inspection revealed that the No.3 Bearing failed leading to Engine No. 2 inflight engine shutdown.

3.2 Causal factor

The failure of No. 3 main line bearing in the front modules of Engine No.2.



4.0 SAFETY RECOMMENDATIONS

No Safety Recommendation were made in this report.