



# AIRCRAFT ACCIDENT REPORT

APL/2021/01/14/F

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**Nigerian Safety Investigation Bureau**

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**Final Report on Serious Incident involving Embraer  
EMB-145LR with nationality and registration marks  
5N-BVD operated by Air Peace Limited which  
occurred at Kaduna Airport, Kaduna on 14th January,  
2021**

This report was produced by the Nigerian Safety Investigation Bureau, (NSIB), Nnamdi Azikiwe International Airport, Abuja.

The report is based upon 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.

In accordance with Annex 13 to the Convention on International Civil Aviation, it is not the purpose of aircraft accident/serious incident investigations to apportion blame or liability.

Readers are advised that Nigerian Safety Investigation Bureau investigates for the sole purpose of enhancing aviation safety. Consequently, Nigerian Safety Investigation Bureau reports are confined to matters of safety significance and should not be used for any other purpose.

As the Bureau believes that safety information is of great value if it is passed on for the use of others, readers are encouraged to copy or reprint for further distribution, acknowledging the Nigerian Safety Investigation Bureau as the source.

Recommendations in this report are addressed to the relevant stakeholders and Regulatory Authority of the State (NCAA). It is for this authority to ensure enforcement.

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## TABLE OF CONTENTS

<b>TABLE OF CONTENTS</b> .....	<b>I</b>
<b>TABLE OF FIGURES</b> .....	<b>V</b>
<b>GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT</b> .....	<b>VI</b>
<b>SYNOPSIS</b> .....	<b>1</b>
<b>1.0 FACTUAL INFORMATION</b> .....	<b>3</b>
1.1 History of the flight.....	3
1.2 Injuries to persons .....	6
1.3 Damage to aircraft .....	7
1.4 Other damage.....	7
1.5 Personnel information.....	7
1.5.1 Pilot .....	7
1.5.2 Co-pilot .....	8
1.5.3 Lead cabin crew.....	8
1.5.4 Engineer .....	8
1.6 Aircraft information .....	9
1.6.1 Power plant.....	10
1.6.2 Load sheet .....	10
1.6.3 Extract from EMB 145 Quick Reference Handbook .....	10
1.6.4 Extract from Air Peace EMB 145 Checklist REVISION 1 .....	11
1.6.5 System description.....	11
1.6.6 Maintenance history .....	19
1.6.7 Post-occurrence inspection of hydraulic system.....	22
1.6.8 Post-occurrence maintenance action .....	22
1.7 Meteorological information.....	23
1.8 Aids to navigation.....	24

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1.9	Communications.....	24
1.10	Aerodrome information.....	24
1.11	Flight recorders.....	27
1.11.1	Flight Data Recorder (FDR) analysis.....	27
1.11.2	Cockpit Voice Recorder (CVR).....	29
1.12	Wreckage and impact information.....	29
1.13	Medical and pathological information.....	33
1.14	Fire.....	33
1.15	Survival aspect.....	33
1.16	Test and research.....	33
1.17	Organizational and management information.....	33
1.17.1	Air Peace Limited.....	33
1.17.2	Nigerian Civil Aviation Authority (NCAA).....	40
1.17.3	Federal Airports Authority of Nigeria (FAAN).....	43
1.18	Additional information.....	45
1.18.1	Excerpts from Civil Aviation (Investigation of Air Accidents and Incidents) Regulations, 2019.....	45
1.18.2	Human factors in flight operations.....	46
1.18.3	Confirmation bias.....	47
1.18.4	Plan Continuation Bias.....	48
1.18.5	High Speed Rejected Take-off.....	48
<b>2.0</b>	<b>ANALYSIS.....</b>	<b>49</b>
2.1	General.....	49
2.2	Conduct of the flight.....	49
2.2.1	Introduction.....	49
2.2.2	Kaduna-Lagos sector.....	50
2.3	Human factors element.....	52



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2.4	Sequence of events during the rejected take-off.....	52
2.5	Air Peace Limited EMB 145 hydraulic fluid replenishment practice.....	53
2.5.1	Post occurrence assessments and maintenance actions.....	54
2.6	Preservation of evidence.....	54
2.7	Aerodrome Rescue and Fire Fighting Services (ARFFS) Response at Kaduna airport55	
<b>3.0</b>	<b>CONCLUSION .....</b>	<b>57</b>
3.1	Findings.....	57
3.2	Causal factor.....	59
3.3	Contributory factors.....	59
<b>4.0</b>	<b>SAFETY RECOMMENDATIONS.....</b>	<b>60</b>
4.1	Safety recommendation 2024-004.....	60
4.2	Safety recommendation 2024-005.....	60
4.3	Safety recommendation 2024-006.....	60
4.4	Safety recommendation 2024-007.....	60
4.5	Safety recommendation 2024-008.....	61
4.6	Safety recommendation 2024-009.....	61
4.7	Safety recommendation 2024-010.....	61
4.8	Safety recommendation 2024-011.....	61
4.9	Safety recommendation 2022-012.....	62
4.10	Safety recommendation 2024-013.....	62
<b>APPENDICES .....</b>		<b>63</b>
	Appendix 1: Load sheet.....	63
	Appendix 2: Certificate of Release.....	64
	Appendix 3: Main wheel assembly service tag.....	67
	Appendix 4: Daily Check for 13th January, 2021.....	68
	Appendix 5: Aircraft maintenance statement.....	69



Appendix 6: Certificate of registration of aircraft..... 70  
Appendix 7: Aircraft certificate of release to service and maintenance statement71

## TABLE OF FIGURES

Figure 1: EMB-145 LR with registration marks 5N-BVD showing the condition of the No.1 main landing gear wheel assembly after the occurrence .....	9
Figure 2: Hydraulic system block diagram.....	14
Figure 3: Location of hydraulic system 1 and 2 components .....	15
Figure 4: Main brake assembly diagram .....	19
Figure 5: ARFFS Watch room/ATC Tower .....	25
Figure 6: ARFFS stationed and vehicles .....	26
Figure 7: ATC tower under construction .....	26
Figure 8: Lagos-Kaduna and aborted flight profiles .....	28
Figure 9: Relevant flight parameters at point of initiation of the rejected take-off ....	28
Figure 10: Sequence of the rejected take-off .....	30
Figure 11: Tyre debris being cleared from the runway.....	31
Figure 12: Damaged number 1 and 2 tyres with hydraulic leakage.....	31
Figure 13: Torn left main landing gear door fairing .....	32
Figure 14: Abraded number 1 left main wheel hub.....	32

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## **GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT**

AAIM	Atlantic Air Industries Maroc
AEP	Airport Emergency Plan
AIB	Accident Investigation Bureau
AMM	Aircraft Maintenance Manual
AOC	Air Operator Certificate
AOL	All Operators Letter
APL	Air Peace Limited
APU	Auxiliary Power Unit
ARFFS	Aerodrome Rescue and Fire Fighting Services
ASP	Assistant Superintendent of Police
ATC	Air Traffic Control
ATPL	Airline Transport Pilot Licence (Aeroplane)
BCU	Brake Control Unit
CAS	Crew Alerting System
CPL	Commercial Pilot Licence (Aeroplane)
CVR	Cockpit Voice Recorder
DFO	Director of Flight Operations
DME	Distance Measuring Equipment
DNKA	Location Identifier for Kaduna Airport
DNMM	Location Identifier for Murtala Muhammed International Airport Lagos
EDP	Engine Driven Pump
EICAS	Engine Indicating and Crew Alert System
EMB	Embraer
EMDP	Electric Motor Driven Pump
FAA	Federal Aviation Administration
FAAN	Federal Airports Authority of Nigeria
FADEC	Full Authority Digital Engine Control
FDR	Flight Data Recorder
FL	Flight Level



F/O	First Officer
GPU	Ground Power Unit
hPa	Hecto Pascal
HYD SYS	Hydraulic System
HYD1 LO QTY	Hydraulic System 1 low quantity
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
KIAS	Knot Indicated Air Speed
Km	Kilometre
Kt	knots
LHS	Left Hand Side
LLWAS	Low Level Wind Shear Alert System
LO QTY	Low Quantity
M	Meter
MCC	Maintenance Control Centre
MD	McDonnell Douglas
MEL	Minimum Equipment List
MET	Meteorology
MFD	Multi-Function Display
MHz	Mega Hertz
NAMA	Nigerian Airspace Management Agency
NCAA	Nigerian Civil Aviation Authority
Nig. CARs	Nigeria Civil Aviation Regulations
NOSIG	No Significant Change
NOTAM	Notice to Airmen
NWS	Nose Wheel Steering
OM	Operations Manual
PA	Public Address system



PCU	Power Control Unit
PF	Pilot Flying
PIC	Pilot-In-Command
PM	Pilot Monitoring
PSI	Pound per Square Inch
QNH	Regional or Airfield Pressure Setting
QRH	Quick Reference Handbook
RHS	Right Hand Side
RTO	Rejected Take Off
RWY	Runway
SAE	Society of Automotive Engineering
SOPs	Standard Operating Procedures
TEMP	Temperature
TR	Thrust Reversers
TWR	Tower
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
VOR	Very High Frequency Omni-Directional Radio Range

<b>Aircraft accident report number:</b>	APL/2021/01/14/D
<b>Registered owner/operator:</b>	Air Peace Limited
<b>Aircraft type and model:</b>	Embraer EMB-145LR
<b>Manufacturer:</b>	Empresa Brasileira DE Aeronautica SA
<b>Year of manufacture:</b>	1999
<b>Nationality and registration marks:</b>	5N-BVD
<b>Serial number:</b>	145199
<b>Location:</b>	Runway 05, Kaduna Airport (DNKA)
<b>Date and time:</b>	14th January, 2021 at 12:11 h <i>(All times in this report are local time (UTC +1) unless otherwise stated)</i>

## SYNOPSIS

Accident Investigation Bureau (AIB), Nigeria was notified of the occurrence by the Nigerian Civil Aviation Authority (NCAA) on 14th January, 2021. Investigators were dispatched same day and commenced post-occurrence assessments, under the provisions of Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019 and ICAO Annex 13.

On 14th January, 2021, an Embraer EMB-145LR aircraft with nationality and registration marks 5N-BVD, operated by Air Peace Limited, was scheduled for passenger flight (four sectors); Lagos-Owerri-Lagos and Lagos-Kaduna-Lagos, with the same flight crew.

At 10:27 h, 5N-BVD departed Murtala Muhammed International Airport Lagos (DNMM) for Kaduna airport (DNKA) for the third sector of the day as flight APK7376 on an Instrument Flight Rules (IFR) flight plan with 53 persons on board (49 passengers and four crew) and fuel endurance of three hours. The Co-Pilot was the Pilot Flying (PF), while the Pilot was the Pilot Monitoring (PM).

On the third sector, as the aircraft was climbing out of Lagos, an advisory light HYD1 LO QTY on the Engine Indicating and Crew Alert System (EICAS) came ON and the

Quick Reference Handbook (QRH) Section 10-7 (HYDRAULIC SYSTEM LOW QUANTITY) was accomplished. The hydraulic level was monitored until landing Kaduna.

While preparing for the fourth sector on ground Kaduna, the Electric Motor Driven Pump (EMDP) was used to power the Hydraulic System. During taxi, the lead cabin crew informed the flight crew that there was an unusual sound from the over wing to the aft of the aircraft. The flight crew concluded that the sound emanated from the EMDP and continued with pre-flight activities.

The aircraft lined up for take-off and as it accelerated towards 119 kt, the take-off was aborted, thus initiating a sequence of events that eventually led to the failure of Numbers 1 and 2 wheel assemblies and additional damage to the aircraft.

The incident occurred at 12:09:20 h, daytime in Visual Meteorological Conditions (VMC).

### **Causal factor**

Operating the aircraft with an unserviceable hydraulic system leading to a high speed rejected take-off.

### **Contributory factors**

1. Leakage of Hydraulic System 1 due to a loose coupling on the hydraulic line servicing the brake control valve.
2. Non-adherence to Air Peace Limited company guidelines on diagnosis and reporting of faults.
3. The non-detection of a hydraulic leakage and non-indication of hydraulic system fail message on the Engine Indicating and Crew Alerting System (EICAS) reinforced the flight crew decision (confirmation bias) to continue with the flight.

**Ten (10) Safety Recommendations were made.**

## 1.0 FACTUAL INFORMATION

### 1.1 History of the flight

On 14th January, 2021, an Embraer EMB-145LR aircraft with nationality and registration marks 5N-BVD, operated by Air Peace Limited, was scheduled for passenger flight (four sectors); Lagos-Owerri-Lagos and Lagos-Kaduna-Lagos, with the same flight crew.

At 10:27 h, 5N-BVD departed Murtala Muhammed International Airport Lagos (DNMM) for Kaduna airport (DNKA) for the third sector as Flight APK7376 on an Instrument Flight Rules (IFR) flight plan with 53 persons on board (49 passengers and four crew) and fuel endurance of three hours. The Co-pilot was the Pilot Flying (PF), while the Pilot was the Pilot Monitoring (PM).

According to the flight crew, as APK7376 was climbing out of Lagos, an advisory message of HYD1 LO QTY (hydraulic 1 low quantity) on the Engine Indicating and Crew Alerting System (EICAS) came ON. The Co-pilot transferred control to the Pilot and read out the Quick Reference Handbook (QRH) Section 10-7 (HYDRAULIC SYSTEM LOW QUANTITY), which advised the flight crew to monitor the affected system. The Co-Pilot took over control of the aircraft again and the flight crew continued to monitor the hydraulic system 1 on the Multi-Function Display (MFD) until landing at the destination airport.

At 11:00 h, APK7376 contacted DNKA Air Traffic Control (ATC) and passed its traffic information as follows; *Lagos to your station FL290 estimating Kaduna 1029Z we have 53-4 crew, endurance is 0245 Echo Mike Bravo 145 5N-BVD.* ATC acknowledged and responded; *Roger APK7376 maintain FL290 as cleared by Kano to KDA VOR no delay expected for ILS approach Runway 05, QNH 1018 contact time 1000.*

At 11:01 h, APK7376 requested for weather information and ATC provided the weather information as follows; *wind is 080°/06 kt CAVOK CAVOK QNH 1018 TEMP 27°C.*

At 11:30 h, APK7376 was cleared to land RWY 05. APK7376 acknowledged.

At 11:32 h, APK7376 landed RWY 05 DNKA.

According to the Pilot, as the aircraft was turned to exit the active runway, he felt a slight stiffness of the Nose Wheel Steering (NWS). The Pilot instructed the Co-pilot to move the Hydraulic System 1 Electric Motor Driven Pump (EMDP 1) Switch from AUTO to ON position. After this, the Nose Wheel Steering became more effective.

At 11:33 h, the ATC observed the slow movement of the aircraft while it was exiting RWY 05 to the apron and asked the Pilot if there was any problem, the crew replied *negative*.

The flight crew further stated that after the passengers had disembarked, the Pilot conducted a walk-around and upon his return to the cockpit, the Co-pilot also did same. Both reported no sign of fluid leakage around the aircraft. The aircraft was then refuelled, and passengers were boarded for the return flight to Lagos. The fault encountered was not recorded in the technical log and was not reported to the Air Peace Limited Operations Control Centre.

At 11:59:02 h, 5N-BVD requested for start-up clearance from ATC for the fourth sector as Flight APK7377, intended destination Lagos, flight level (FL) 280 on an Instrument Flight Rules (IFR) flight plan with 53 persons on board (49 passengers and four crew) and fuel endurance of 3 hours 25 minutes.

At 11:59:32 h, start-up request was approved by ATC with the following information: QNH1017, temperature 29°C, and departure RWY 05.

At 12:00:58 h, APK7377 requested for taxi and was cleared to holding position RWY 05 for departure. The flight crew acknowledged the clearance.

At 12:03:41 h, as the flight crew were discussing issues encountered after the last landing, the Lead Cabin Crew called to inform them of an unusual sound in the cabin. The Pilot enquired about the nature of the sound and its location, to which the Lead Cabin Crew informed them that it was from the rear of the cabin and then mimicked a

humming sound as a description, the flight crew noted. The flight crew then referred to section 10-7 the Emergency/Abnormal checklist of the Quick Reference Handbook (QRH). The Pilot then requested for the QRH requirement for Engine Driven Pump failure.

At 12:05:41 h, APK7377 was cleared to Lagos via airway UV377, to climb and maintain FL280 and to squawk A0612. The clearance was acknowledged.

At 12:06:07 h, ATC called APK7377 to confirm readiness for departure and APK7377 responded; *negative, stand-by*.

Information obtained from the CVR revealed that further reference to failure of the EDP and the non-indication of hydraulic system one fail message was made by the flight crew, and they decided to use the EMDP. The effects of hydraulic system failure, which include runway excursion after landing were then discussed.

At 12:07:25 h the Lead Cabin Crew called again to inform the flight crew that the sound persisted, and it was emanating from the wing section all the way to the aft of the aircraft and there was no presence of any strange odour or smoke when enquired by the flight crew. The flight crew acknowledged this information and continued with the flight.

At 12:08:14 h, APK7377 informed the ATC that it was ready for departure and ATC issued clearance as follows; *wind 090°/06 kt, after departure left turn, clear to take-off RWY 05*. The flight crew acknowledged.

At 12:08:32 h, the right side (Co-pilot side) EICAS page was put on the hydraulic page to monitor the hydraulic systems.

According to the flight crew, after lining up for take-off, engine parameters were checked and found okay. The Co-pilot assumed the role of the Pilot Flying (PF) while the Pilot was the Pilot Monitoring (PM).

The flight crew stated that during the take-off roll, as the aircraft accelerated to 110 KIAS, the crew experienced heavy vibrations and shaking of the control column. The

PM then took over control of the aircraft, aborted the take-off. The Flight Data Recorder indicated that the air speed was 119 kt when the throttle lever was retarded, HYD1 LO QTY came ON immediately afterwards. (The hydraulic fluid quantity data is not recorded on the FDR and the CVR did not capture any aural warning at this instance). The Number 1 Thrust Reverser did not deploy. The aircraft came to a stop about four meters left of the runway centreline and 284 m short of the end of RWY 05.

At 12:10:06 h, ATC called to confirm if APK7377 had a tyre problem and the Co-pilot responded *affirm sir*. The ATC then informed the Aerodrome Rescue and Fire Fighting Services (ARFFS) watchman that was co-located in the same watch room. The ARFFS arrived four minutes 11 seconds after the ATC call. Upon arrival, the ARFFS inspected the aircraft, found out that the Numbers 1 and 2 tyres were damaged and reported same to the flight crew. The Pilot briefed the passengers of the situation via the Public Address (PA) system. The passengers then disembarked the aircraft through the main entry door and were taken back to the terminal.

The incident occurred at 12:09:20 h, daytime in Visual Meteorological Conditions (VMC).

## 1.2 Injuries to persons

<b>Injuries</b>	<b>Crew</b>	<b>Passengers</b>	<b>Total in the aircraft</b>	<b>Others</b>
<b>Fatal</b>	Nil	Nil	Nil	Nil
<b>Serious</b>	Nil	Nil	Nil	Nil
<b>Minor</b>	Nil	Nil	Nil	Nil
<b>None</b>	4	49	53	Nil
<b>Total</b>	4	49	53	Nil



### **1.3 Damage to aircraft**

The aircraft was slightly damaged.

### **1.4 Other damage**

None

### **1.5 Personnel information**

#### **1.5.1 Pilot**

Nationality:	British
Age:	64 years
Licence type:	Airline Transport Pilot Licence (Aeroplane)
Licence:	Valid till 5th May, 2021
Aircraft ratings:	Piper Aztec-23, BAC 1-11, Boeing 737-300, DC-9, Airbus 330-200, Embraer-145, MD-80, Boeing 737-NG, Airbus 330, Airbus 300-600, FALCON-20
Medical certificate:	Valid till 31st July, 2021
Simulator:	Valid till 31st March, 2021 (NCAA Covid-19 dispensation)
Total flying time:	14210:30 h
Total on type:	1200 h
Total on type (PIC):	939:16 h
Last 90 days:	144:05 h
Last 28 days:	81 h
Last 7 days:	21:45 h
Last 24 hours:	3 h

### 1.5.2 Co-pilot

Nationality:	Nigerian
Age:	23 years
Licence type:	Commercial Pilot Licence (Aeroplane)
Licence:	Valid till 13th July, 2021
Aircraft ratings:	Embraer 135/145
Medical certificate:	Valid till 13th July, 2021
Simulator:	Valid till 31st January, 2021
Total flying time:	1116:05 h
Total on type:	960 h
Last 90 days:	152:30 h
Last 28 days:	90:55 h
Last 7 days:	13:15 h
Last 24 hours:	3 h

### 1.5.3 Lead cabin crew

Nationality:	Nigerian
Age:	38 years
Licence type:	Cabin Crew Licence
Licence:	Valid till 3rd February, 2021
Aircraft ratings:	Boeing 767-300, Boeing 737-300/500, Boeing 777-200/300, ATR42, Embraer 135/145, Boeing 747-300/400
Medical certificate:	Valid till 6th February, 2022

### 1.5.4 Engineer

Nationality:	Zimbabwean
Age:	38 years
Licence:	Valid till 29th May, 2021
Licence type:	Aircraft Maintenance Engineer Licence

5N-BVD

Aircraft ratings: Jetstream 4100, Embraer 135/145, British Aerospace BAe-146-200, BAe 146-RJ 85 A

## 1.6 Aircraft information

Type: Embraer-145LR  
Manufacturer: Empresa Brasileira DE Aeronautica SA  
Year of manufacture: 1999  
Serial number: 145199  
Certificate of Airworthiness: Valid till 6th December, 2021  
Certificate of insurance: Valid till 8th April, 2021  
Certificate of registration: Issued on 15th July, 2019  
Noise Certificate: Issued on 25th October, 2017  
Total airframe time: 41786:36 h  
Total landing cycles: 36054



**Figure 1:** EMB-145 LR with registration marks 5N-BVD showing the condition of the No.1 main landing gear wheel assembly after the occurrence

### 1.6.1 Power plant

Engine	Number 1	Number 2
Manufacturer	Rolls Royce, UK	Rolls Royce, UK
Type/Model	AE30071AP	AE30071AP
Date of manufacture	23 October, 1999	18 November, 2001
Serial number	CAE311281	CAE312086
Time since new	36469:21 h	31793:01 h
Cycles since new	31891	25392

Fuel used: Jet A1

### 1.6.2 Load sheet

Dry Operating Mass	-	12676 Kg
Actual Zero Fuel Mass	-	17022 Kg
Maximum Zero Fuel Mass	-	17900 Kg
Actual Take-Off Mass	-	20122 Kg
Maximum Take-Off Mass	-	22000 Kg
Actual Landing Mass	-	18722 Kg
Maximum Landing Mass	-	19300 Kg

See Appendix 1 for the Load sheet completed for this flight.

Information obtained from the CVR indicated that the Pilot had shown concern about the weight of the aircraft during cockpit pre-departure preparation.

### 1.6.3 Extract from EMB 145 Quick Reference Handbook

#### ***EMERGENCY/ABNORMAL PROCEDURES***

#### ***HYDRAULIC SYSTEM LOW QUANTITY***

***EICAS Advisory:*** HYD1 (2) LO QTY

***MFD Indication:*** Hydraulic fluid quantity may be amber.

***Affected Hydraulic System.....MONITOR***

***NOTE:*** If Hydraulic System 2 is affected, do not open the speed Brakes.

***END***

## 1.6.4 Extract from Air Peace EMB 145 Checklist REVISION 1

### **AFTER START**

<i>Aircon/Pneum Panel.....</i>	<i>SET.....</i>	<i>LP</i>
<i>Elechyd Pumps.....</i>	<i>AUTO.....</i>	<i>LP</i>
<i>APU/GPU.....</i>	<i>OFF.....</i>	<i>LP</i>
<i>FADECs.....</i>	<i>RESET/ALTN.....</i>	<i>LP</i>
<i>Thrust Rating/TO Data.....</i>	<i>CKD/SET.....</i>	<i>LP</i>
<i>Shed buses.....</i>	<i>AUTO.....</i>	<i>LP</i>
<i>Steering.....</i>	<i>ON.....</i>	<i>LP</i>
<i>Rudder.....</i>	<i>CKD.....</i>	<i>P</i>
<i>Flaps.....</i>	<i>SET.....</i>	<i>P</i>

## 1.6.5 System description

### 1.6.5.1 Hydraulic system

Excerpts from EMB145 Aircraft Maintenance Manual 29-00-00

*The hydraulic power has two independent and identical systems, identified as hydraulic system 1 and hydraulic system 2. They supply constant pressure and variable flow.*

*The fluid used is the SAE AS1241 Type IV, a fire-resistant phosphate ester-base fluid.*

*The nominal pressure of the systems is 3000 psi (pressure range: 2900 ± 200 psi.).*

#### *General Description*

*The HYDRAULIC POWER includes these subsystems:*

- *MAIN HYDRAULIC SYSTEM*
- *INDICATING*

*The hydraulic power system supplies pressure for the operation of the following systems:*

- *Rudder*
- *Aileron*
- *Spoilers*
- *Landing gear*
- *Brakes (normal and emergency)*
- *Nose wheel steering*
- *Main door*
- *Thrust reverser actuation (optional)*

*One engine-driven pump and one standby electrical motor driven pump (EMDP) supply each system.*

*The hydraulic system 1 has a priority valve which isolates the landing gear system.*

*The flight control services are more important than the landing gear operation.*

*This priority valve closes only during the landing gear operation, with the electrical-motor-driven pump supplying the system.*

*Each system has one accumulator. One supplies hydraulic fluid to the landing gear/main door (Sys 1), and the other to the emergency parking brake (Sys 2).*

*The electrical motors which drive the hydraulic pumps have a cross electrical supply: the DC Bus 2 supplies the EMDP of system 1, and the DC Bus 1 supplies the EMDP of system 2.*

*Hydraulic power from system 1 and 2 supply pressure for the rudder control at the same time. These systems have manual reversion. Hydraulic assistance is necessary for rudder control in the event of asymmetric thrust (single engine condition). With symmetric thrust, the manual reversion is effective. In case of hydraulic power loss, the rudder control system reverts to a damping mode.*

*Both hydraulic power system 1 and hydraulic power system 2 also supply the two aileron hydraulic power units (PCA). Hydraulic power is necessary for single engine*

*control (just one of the systems). If a hydraulic power loss occurs, the aileron control goes back to a damping mode.*

*Hydraulic power is necessary for the spoiler extension and retraction. The inboard spoiler panels, when operated on the ground, has the function of lift dumpers. The outboard panels operate in flight as speed brakes, and on the ground, as lift dumpers. If a power loss occurs, an internal lock keeps the actuator retracted.*

*Hydraulic power is necessary to retract and extend the landing gear. Hydraulic power is also necessary to keep the nose landing gear doors closed with the landing gear retracted. The system has an accumulator which keeps the pressure of hydraulic system 1 in approximate 3000 psi during the systems operations. In case of failure in the hydraulic system 1, the free-fall system operates independently by cables to unlock the landing gear which is consequently extended by gravity.*

*Inboard and outboard brakes operate the four main wheels with anti-skid and differential braking functions. The emergency/parking brake uses an accumulator.*

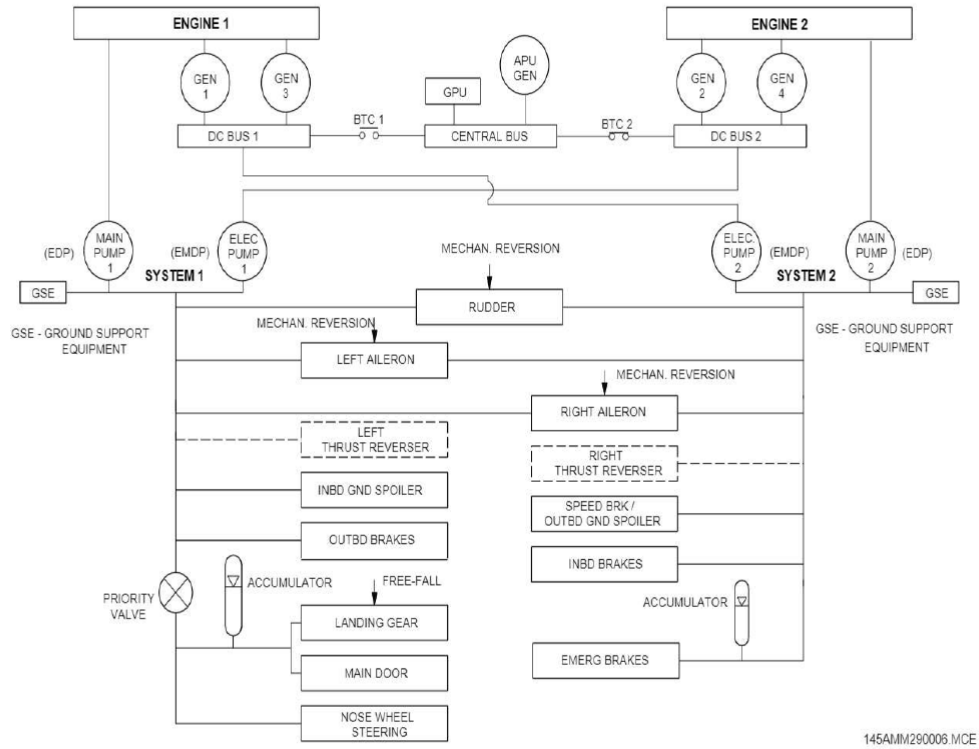
*The hydraulic actuator of the nose wheel steering uses the system 1 hydraulic power only. If a hydraulic failure occurs, the hydraulic steering unit (PCU) goes back to a shimmy damping mode.*

*The hydraulic power operates the thrust reverser panel. Any hydraulic failure cancels the thrust reverser operation.*

*Hydraulic power is necessary only to close the main door. The opening operation of the door is by gravity, controlled by a hydraulic damping mode. When we close hydraulic system 1, an accumulator keeps energy to close the door.*



EFFECTIVITY: ALL

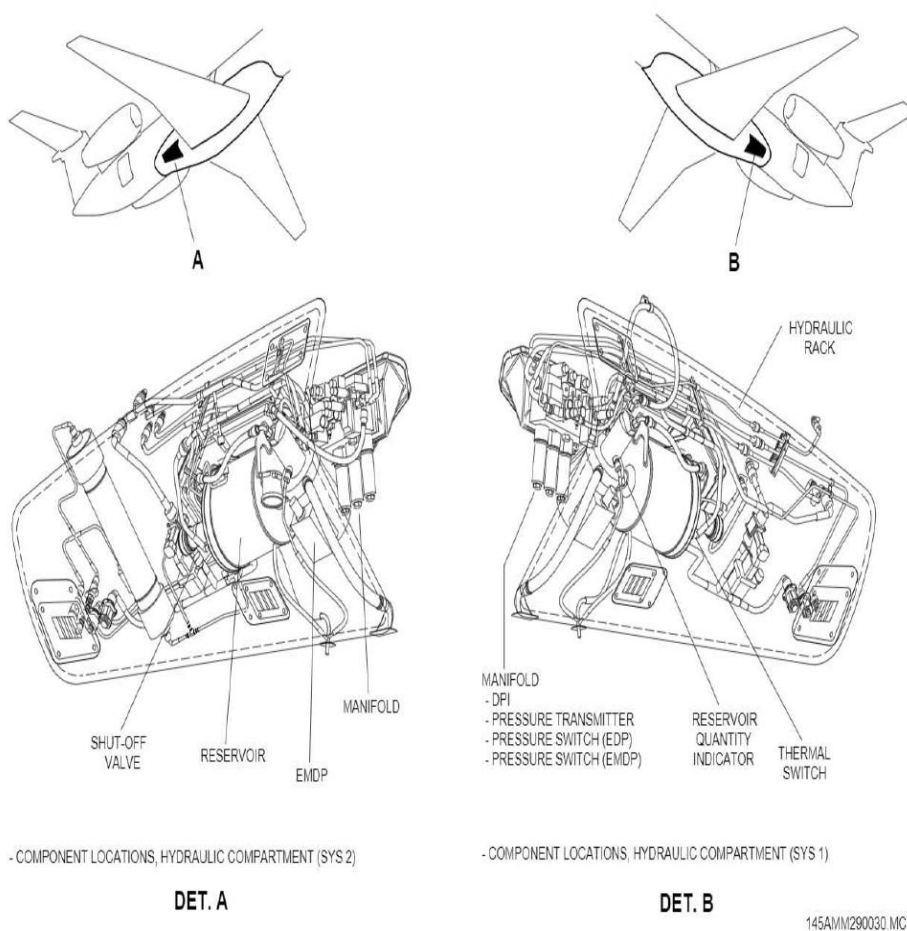


**Figure 2:** Hydraulic system block diagram





EFFECTIVITY:ALL



EMB-145 - SDS 1124

HYDRAULIC SYSTEM 1 AND 2 COMPONENTS

29-00-00

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Page 9 of 12  
 Rev 37 - Jan 15/16

**Figure 3:** Location of hydraulic system 1 and 2 components

## **Components**

### **MAIN HYDRAULIC SYSTEM**

*The primary sources of hydraulic power of systems 1 and 2 are two engine-driven pumps, one for each engine, and two standby pumps driven by electrical motors.*

### **INDICATING**

*The "EICAS (Engine Indicating and Crew Alerting System)" display supplies information about system status and malfunctions to flight and maintenance crew.*

#### **1.6.5.2 SYSTEM PAGE**

*The multi-function display and reservoir fluid quantity related to each system (1 and 2). There is also the (electrical-motor-driven) pump status.*

*A linear analog type indication (horizontal) shows the reservoir fluid quantity. The indication has a pointer and two colors (green and amber).*

<b>HYD FLUID QTY (LITER)</b>	<b>POINTER</b>
<i>1 OR LESS</i>	<i>AMBER</i>
<i>MORE THAN 1</i>	<i>GREEN</i>

*The System pressure is shown digitally.*

*The indication is green or amber as a function of the systems pressure range.*

<b>HYD PRESS VALUE (PSI)</b>	<b>DIGITS</b>
<i>LESS THAN 1300</i>	<i>AMBER</i>
<i>1300 TO 3300</i>	<i>GREEN</i>
<i>ABOVE 3300</i>	<i>AMBER</i>

*A green message "ON or OFF" shows the electric pump status.*

#### **1.6.5.3 Electrical Motor Driven Pump**

*A fuse at supply line protects the electric motor, against the pump/electrical motor become locked or electrical short.*

*The motor includes:*

- *A noise suppressor filter*
- *a thermal switch, which turns the motor off if occurs a temperature higher than 150°C*
- *a fan for cooling the motor*

*The principle of operation is the same as the Engine Driven Pump*

**CONTROL      ELECTRICAL MOTOR DRIVEN PUMP CONDITION**  
**SW**

**POSITION**

*OFF                      DEENERGIZES THE PUMP*

*AUTO                    THE PUMP WILL BE ACTIVATED THROUGH THE PRESSURE SWITCH,  
WHEN THE HYDRAULIC PRESSURE DROPS BELOW 1600 PSI*

*ON                        THE PUMP OPERATES AT CONTINUOUS RATE. WE CAN USE THIS  
POSITION FOR MAINTENANCE GROUND TESTS.*

**1.6.5.3.1      Pressure transmitter**

*The pressure transmitter is in the hydraulic manifold.*

*The pressure transmitter is downstream of the junction of the two pressure lines that come from the hydraulic pumps (electrical and main pumps).*

*The pressure transmitter changes the hydraulic pressure into electrical signals and sends them to the EICAS display (mode Hyd).*

**1.6.5.3.2      Pressure Switch**

*Each system uses two pressure switches*

*-one for the main pump and the other for the electrical pump outlets.*

*The pressure switch, installed in the main pump pressure line has the function of operating the CAS warning message (Hyd 1 Epump Fail) on the "EICAS" display. This occurs when the pressure drops to 1600±100psig (Pound per square Inch Gauge).*

*The pressure to set the warning message to off is 2000psig.*

*Adjacent to the warning light, the pressure switch also energizes the electrical hydraulic pump. This occurs only if the control switch of the electrical hydraulic pump is at "AUTO" position.*

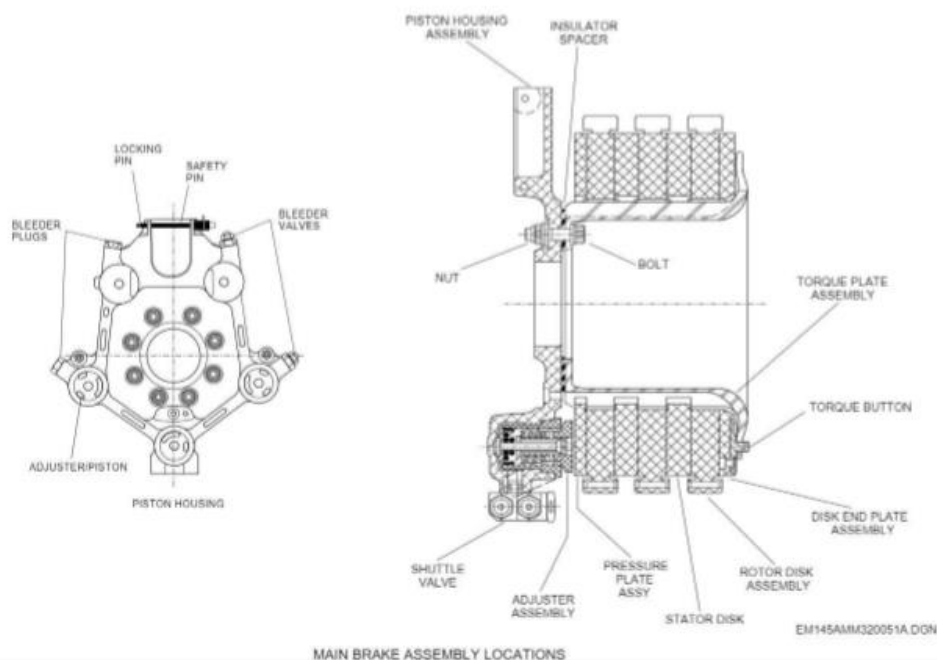
*The pressure switch, installed in the electrical-pump pressure-line, only operates the CAS warning message (Hydr Syst 1 Fail) on the "EICAS" display. This occurs when the pressure drops to  $1300 \pm 100$ psig.*

### **1.6.5.3      Wheels Brakes and Tires**

1. Excerpts from EMB145 Aircraft Maintenance Manual 32

*The wheel brake assembly receives the control pressure from the Brake Control Unit (BCU) to reduce the aircraft speed after landing and during taxi operations.*

*The brake assembly is of the multi-disc type with hydraulic actuation and made by BF Goodrich. Each landing gear (main and nose) has two wheel assemblies. Each wheel assembly has a wheel and a tubeless tire. The wheels of the main and nose gears are a split-type assembly made of forged aluminum. The tires of the main and nose gears are of the tubeless type. Two spin brakes cause the nose landing gear wheels to stop turning, when the nose landing gear retracts. The figure "MAIN BRAKE ASSEMBLY LOCATION" shows the location of the main brake assembly.*



**Figure 4:** Main brake assembly

### 1.6.6 Maintenance history

Air Peace Limited (APL) acquired the ERJ-145 aircraft from Kingman Air Services Incorporation, Arizona-USA in June 2017 and was registered with the Nigerian Civil Aviation Authority (NCAA) with certificate number 1581 on 16th October, 2017.

The ERJ-145 5N-BVD aircraft Technical Log provided the following maintenance history:

Date	Tech log page number	Defects	Action taken
27 March 2020	00002641	AAIM MAINT ENTRY	Preservation of Aircraft and Engines
22 May 2020	00002641	AAIM MAINT ENTRY	De-preservation of Aircraft and Engines
12 October 2020	00002642	AAIM MAINT ENTRY	APU Replaced
19 October 2020	00002642	AAIM MAINT ENTRY	Right Hand Engine replaced
22 October 2020	00002642	AAIM MAINT ENTRY	Performed Scheduled Maintenance
27 October 2020	00002644	Loud noise from main door	Daily Check performed Pre-flight performed

5N-BVD

			Performed adjustment of main door seal
			Performed Pressurization
28 October 2020	00002645	AAIM MAINT ENTRY	Daily Check Performed
			Weekly Check Performed
02 November 2020	00002646	AAIM MAINT ENTRY	Daily Check carried out
			Preflight completed
05 November 2020	-	-	Short out of operation maintenance
12 November 2020	-	-	Preservation of aircraft
13 November 2020	-	-	Preservation of engines
30 November 2020	-	-	De-preservation of engines and aircraft returned to service
10 December 2020	00002682	-	Routine hydraulic fluid systems test
20 December 2020	00002766	Both nose wheel assemblies worn to limits	Both nose wheel assemblies replaced
23 December 2020	00002796	No. 2 main wheel worn out	No. 2 main wheel replaced
24 December 2020	00002804	No. 1 main landing gear wheel worn to limit	No. 1 main landing gear wheel replaced
		No. 4 main landing gear wheel worn to limit	No. 4 main landing gear wheel replaced
29 December 2020	00002835	No. 3 main landing gear wheel worn to limit	No. 3 main landing gear wheel replaced

The aircraft was put in storage from 27th March, 2020 to 22nd May, 2020 and was de-preserved on 22nd May, 2020. On 12th October 2020, the APU with part number M4504113A and serial number SP-E0414760 was installed and on 19th October 2020,

the right (No. 2) engine with part number AE3007AI and serial number CAE311404 was replaced with another engine with part and serial number SP-E0214435 and CAE312086 respectively.

5N-BVD was ferried to Atlantic Air Industries Maroc (AAIM) Hangar, a maintenance facility at Ben Slimane (GMD), Casablanca-Settat, Morocco for a C-check.

The check was carried out from 27th May to 28th October, 2020. See Appendix 2: Aircraft Certificate of Release to Service.

The operator was issued with a Special Flight Permit (Certificate No. 1581) dated 27th October, 2020 by the Nigerian Civil Aviation Authority (NCAA) to ferry 5N-BVD from the maintenance facility back to APL base in Lagos.

On 2nd November 2020, the aircraft departed GMD and arrived Lagos (DNMM) same day. Post-arrival inspection was conducted and the report was issued on the 10th November 2020. The aircraft was put in short-term storage on 5th November 2020 and was de-preserved on 30th November 2020. Airworthiness Certificate number 1581 was renewed from 7th December 2020 to 6th December 2021.

On 10th December 2020, a routine hydraulic fluid systems test was carried out.

On 20th December 2020, the left and right nose wheel tyres Part Number 3-1551 and Serial Numbers 0426 and 0611 were replaced with Serial Numbers 1792 and 2861 respectively.

From 23rd to 24th December 2020, the No. 1 and No. 2 main wheel tyres Part Number 1641 Serial Numbers 10438 and 1027/3432P were replaced with Serial Numbers 3715/0319P and 5954 respectively.

On 24th December 2020, the No. 4 main wheel assembly was removed and replaced, and on 29th December, the No. 3 main wheel assembly was removed and replaced. See Appendix 3: Main wheel assembly service tag.

The maintenance job card JC NO.: E145001APL-EMB for the aircraft showed that the night before the incident (13th January 2021), the daily check (post-flight inspection) was carried out on 5N-BVD and the hydraulic system 1 and 2 reservoir fluid levels were checked and refilled with five (5) quarts of SAE AS1241 Type IV (Skydrol LD4). See Appendices 4a, 4b and 4c.

### **1.6.7 Post-occurrence inspection of hydraulic system**

1. Hydraulic fluid level indicator for System 1 Reservoir showed fluid quantity was below 1.057 quarts.
2. A hydraulic brake hose coupling underneath the number 1 main landing gear was found loose and dripping hydraulic fluid intermittently. Upon tightening the connecting pipe, the leakage stopped.

### **1.6.8 Post-occurrence maintenance action**

1. On 15th January 2021, the following maintenance actions were carried out on the aircraft in preparation for ferry back to Air Peace Limited base:
  - a. Replacement of Number One Main Wheel Assembly
  - b. Replacement of Number Two Main Wheel Assembly
  - c. Replacement of Number One Brake Assembly
  - d. Replacement of Number Two Brake Assembly
2. On 16th January 2021, further maintenance actions were carried out on the aircraft in preparation for ferry back to APL base:
  - a. Tightening and securing of loose Switch Connector
  - b. Replacement of Number One Nose Wheel Assembly
  - c. Replacement of Number Two Nose Wheel Assembly



3. On 17th January 2021, the following maintenance actions were carried out on the aircraft in preparation for ferry back to APL base:
  - a. Replacement of Left Main Landing Gear Lower Door
  - b. Replacement of Left Main Landing Gear Upper Door
4. On 19th January 2021, the following maintenance actions were carried out on ground the APL base:
  - a. Tightening, securing and ground testing of Loose Union (after finding a hydraulic fluid leak on the underwing)
  - b. Certificate of Fitness for flight was issued.
5. On 20th January 2021, the following maintenance actions were carried out on ground the APL base:
  - a. Replacement of Hydraulic System Number One Pressure Switch
  - b. High Energy Stop Inspection

The aircraft was subsequently issued with a Certificate of release to Service REF NCAA/DAWS/AD1103/VOL.8/34 on 22nd January, 2021. See Appendix 8.

## 1.7 Meteorological information

<b>DNKA</b>	<b>1100 Z</b>
Wind:	080°/11 kt
Visibility:	10 km
Weather:	Nil
Cloud:	NSC
Temp/Dew point:	29°C/10°C
QNH:	1017 hPa

## 1.8 Aids to navigation

The conditions of the navigational aids at Kaduna airport on the day of the occurrence were as follows:

'KDA' VOR/DME 115.3 MHz	Serviceable
'KUA' VOR 114.7 MHz	Serviceable
'IKA' ILS	Serviceable
Localiser 110.1 MHz	Serviceable
Glideslope 334.4 MHz	Serviceable
Wind Velocity Indicator	Unserviceable
Digital Anemometer	Serviceable
Aldis Lamp	Serviceable
Low Level Windshear Alert System	Unserviceable

## 1.9 Communications

There was effective communication between the ATC and the flight crew. The serviceability of the communication aids at Kaduna airport on the day of the occurrence were as follows:

Very High Frequency (VHF) 118.8 MHz	Serviceable
VHF 121.7 MHz	Serviceable
Intercom Phone	Serviceable

## 1.10 Aerodrome information

Kaduna airport (DNKA) is located 29 km North-West of Kaduna with coordinates 10°41'39.4"N 7°19'06.0"E and has an elevation of 632 m. The aerodrome has a runway of an asphalt/concrete surface with orientation of 05/23. The length and width of the runway are 3000 m and 60 m respectively.

The ATC in Kaduna was co-located with the ARFFS watch room at the time of occurrence. The watch room provides limited viewing of the extreme end of runway 05.

During the post occurrence interview, the ARFFS supervisor noted that the aircraft was spotted moving at a slow speed and that a cloud of dust was spotted from the left main landing gear. After ATC called the aircraft, ARFFS personnel that were mounted on a fire tender were dispatched to the aircraft where it was confirmed to be a tyre failure.

The ARFFS was equipped with three fire tenders, one of which (E-One 21) was unserviceable at the time of occurrence.

Records indicate that the last Response Time Test was conducted in July 2018, two years prior to this occurrence and the airport does not have an approved Airport Emergency Plan.



**Figure 5:** ARFFS Watch room/ATC Tower

5N-BVD



**Figure 6:** ARFFS station and vehicles



**Figure 7:** ATC tower under construction

## 1.11 Flight recorders

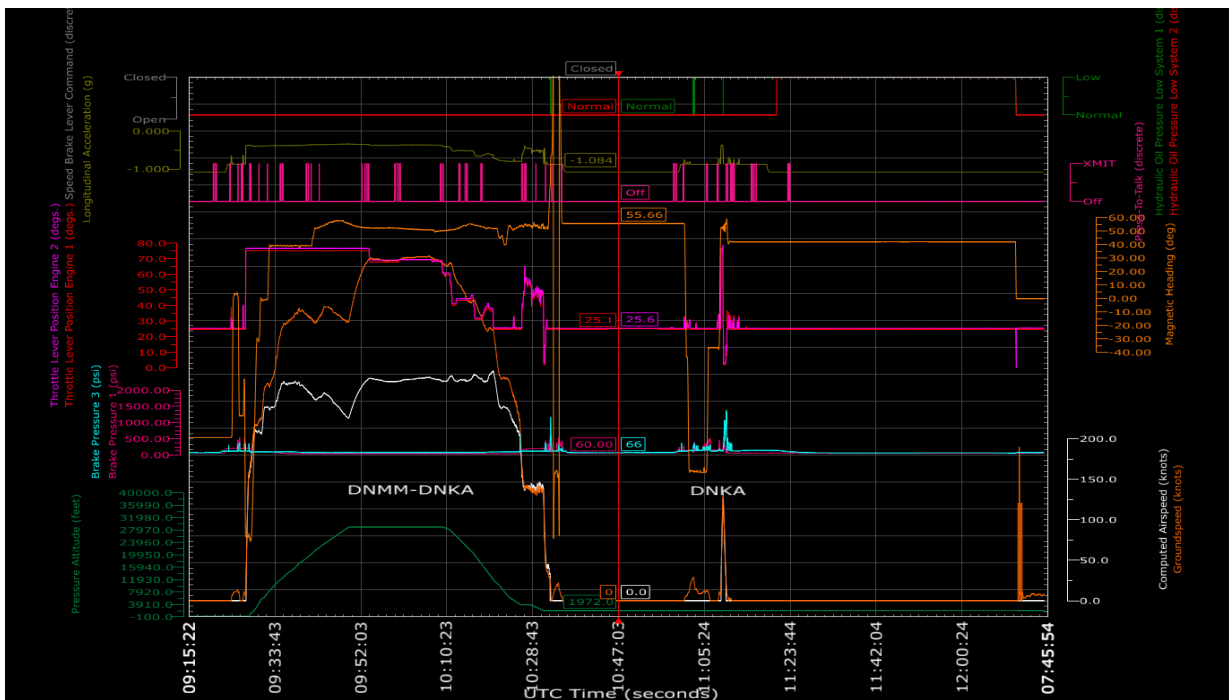
The aircraft is equipped with a Flight Data Recorder (FDR) and a Cockpit Voice Recorder (CVR). The FDR was downloaded in-situ and the CVR was downloaded at the Accident Investigation Bureau (AIB) Safety Laboratory, Abuja.

The flight recorders have the following particulars:

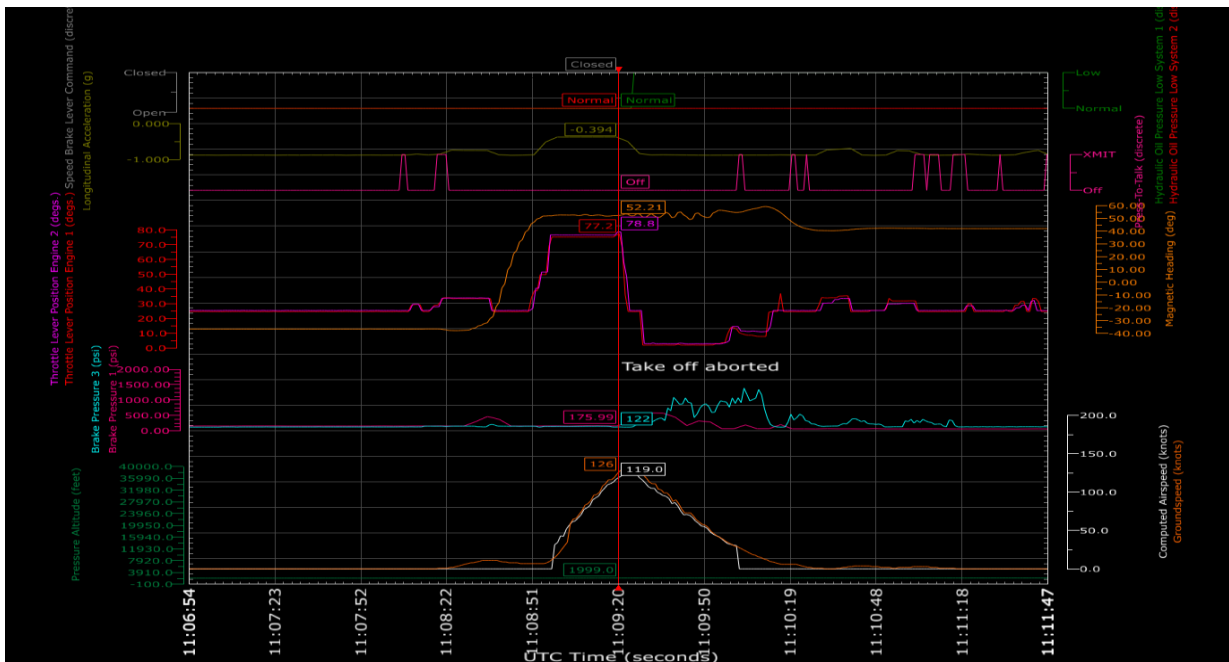
<b>Recorders</b>	<b>Flight Data Recorder</b>	<b>Cockpit Voice Recorder</b>
<b>Manufacturer</b>	Honeywell International Inc., USA	Honeywell International Inc., USA
<b>Model</b>	Solid State Flight Data Recorder	Solid State Memory Cockpit Voice Recorder
<b>Part Number</b>	980-4700-042	980-6022-001
<b>Serial Number</b>	SSFDR-09677	CVR120-06507

### 1.11.1 Flight Data Recorder (FDR) analysis

The FDR showed that the take-off was aborted at a computed airspeed of 119 kt. Thereafter, the Number 1 Thrust Reverser did not deploy and hydraulic fluid pressure for Number 1 system became low. Brake pressure was applied to bring the aircraft to a stop.



**Figure 8:** Lagos-Kaduna and aborted flight profiles



**Figure 9:** Relevant flight parameters at point of initiation of the rejected take-off 1

1Time on the plot is UTC

### **1.11.2 Cockpit Voice Recorder (CVR)**

After the high speed rejected take-off, the engines were shut down but the APU was left running and the CVR was not deactivated. Some portions of the recordings relevant to the occurrence were overwritten. During the post occurrence interview, the flight crew expressed their unfamiliarity with the requirement to deactivate the CVR following accidents/incidents.

### **1.12 Wreckage and impact information**

FAAN officials of Kaduna airport had cleared the tyre debris on the runway before the arrival of AIB investigators. The aircraft was also moved from the occurrence site without the permission of AIB.

Witness marks on the runway indicated that during the take-off roll, at about 756 m from the threshold of RWY 05, the number 2 main wheel tyre burst (inboard left main wheel) and the aircraft continued for a distance of about 1300 m where the number 1 left main wheel tyre burst (outboard left main wheel). The aircraft continued for another 200 m (2256 m from RWY 05 threshold) where runway to metal contact was observed and thereafter moved in a ground loop pattern for 460 m.

The aircraft finally stopped 284 m to the end of RWY 05 at a magnetic heading of 031°, four meters left of the runway centreline. The aircraft rested on the left main landing gear wheel hubs with hydraulic fluid spillage underneath.



**Figure 10:** Sequence of events during the rejected take-off

The following damages were observed:

1. The plies of the Number 1 tyre were shredded and the beads remained on the flange.
2. Number 2 tyre had flat spot and portions of the plies were shredded; the beads were not detached from the flanges.
3. The flanges of the two left main wheel hubs were abraded.
4. Left main landing gear door fairing was torn.





**Figure 11:** Tyre debris being cleared from the runway



**Figure 12:** Damaged number 1 and 2 tyres with hydraulic leakage



**Figure 13:** Torn left main landing gear door fairing



**Figure 14:** Abraded number 1 left main wheel hub

### **1.13 Medical and pathological information**

Medical and toxicological tests were not carried out.

### **1.14 Fire**

There was no fire.

### **1.15 Survival aspect**

The incident was survivable. The structural integrity of the cabin was not compromised.

### **1.16 Test and research**

Not applicable

### **1.17 Organizational and management information**

#### **1.17.1 Air Peace Limited**

Air Peace Limited (APL) is a private airline founded in 2013 with its head office in Lagos State, Nigeria. Its operating Base is Murtala Muhammed International Airport. In addition to charter services, it also serves major cities in Nigeria and flies to 20 destinations including West Africa and the Middle East. Air Peace Limited holds an approved Air Operator Certificate (AOC) issued on the 8th of September 2018 Number; APL/AOC/09-14/01, valid till 7th September, 2020.

Air Peace Limited has a total of 27 aircraft: 16 Boeings (13 B737 and 3 B777), and 8 Embraer ERJ-145 and 3 Embraer E195.

Air Peace designations are: P4 (IATA), APK (ICAO) and PEACE BIRD (Call sign).

### **1.17.1.1 Excerpts from Air Peace Operations Manual (OM PART A)**

#### ***1.5.1.3 Special Responsibilities***

*The First Officer shall:*

*a) Carry out such duties concerning the flight, in accordance with SOPs, including procedures, limitations and performance relating to the specific aeroplane type, as are allocated to him by the Commander;*

*b) Confirm the safe navigation of the aeroplane, maintaining a continuous and independent check upon both the geographical position of the aeroplane and its safe terrain clearance;*

*c) Volunteer such advice, information and assistance to the Commander as may contribute favourably towards the safe and efficient conduct of the flight;*

*d) Seek and receive such information and/or explanation from the Commander as may be necessary to enable the Co-pilot to fulfill his function;*

*e) Maintain a high personal standard of discipline, conduct and appearance as a representative of the Company;*

*e) Support the Commander, by active example, in the development and maintenance of a high standard of professional expertise and morale amongst the crew;*

*f) Report to the Commander any incident that endangered, or could have endangered, the safety of operation;*

*h) Pre-flight:*

*i) A Co-pilot must be fully aware of the planned flight route, contents of briefing sheets, and the forecast MET conditions and runway status at the destination and alternate aerodromes;*

*ii) Carry out all checks specified in the Operations Manual and complete all necessary*

*documents;*

*iii) Monitor and supervise re-fuelling as necessary and check that the correct flight plan fuel quantity is on board.*

### **1.17.1.2 Excerpts from Air Peace Operations Manual (OM PART A)**

#### **8.1.11.2 Contents of the Technical Log**

*AIR PEACE LIMITED uses an approved Technical Log as shown in Chapter. 14 of this manual, The technical logbook is designed to provide flight crew and maintenance personnel with means of recording malfunctions, corrective action and other relevant information that is of value to the operation. One copy of each page may remain on the aeroplane and one other copy may be retained on the ground until completion of the flight to which it relates. Its layout is divided to show clearly what is required to be completed after flight and what is required to be completed in preparation for the next flight.*

*The Technical Log consists of four serialised colour coded copies and bound in sets of 50 each as follows:*

- a) WHITE: Tech. Rec/Planning;*
- b) YELLOW: Maintenance Engineering;*
- c) GREEN: Departing Station;*
- d) PINK: OCC/Flt Ops.*

#### **8.1.11.2.5 Aircraft Technical Log: Defect Entries**

*a) Air Peace Limited requires the PIC to ensure that all mechanical irregularities or suspected defects that affect operation of the aircraft including Cabin Defects occurring during flight time are entered in the aircraft maintenance records section of the technical log for the aircraft at the appropriate points before, during and at the*

*end of that flight time. Technical defects are to be entered at the end of the flight sector on which they are first noted. The flight crew must ensure that all information entered in the Aircraft Technical Log:*

*i) is up to date;*

*ii) legible;*

*iii) cannot be erased;*

*iv) is correctable in the case of an error provided each correction is identifiable and errors remain legible.*

### ***b) Damage to Aircraft***

*Whenever the Captain becomes aware of any damage being, or having been, caused to an aircraft, he is to have the damage inspected by an engineer and ensure an appropriate entry is made in the technical log prior to the next flight. Great care is to be exercised when away from base ensuring that damage is assessed correctly bearing in mind the complex nature of modern aircraft construction and the exact implications of what might appear to be superficial damage.*

### ***c) Rectification Work***

*Rectification work on Air Peace Limited aircraft may only be carried out by an engineer holding the airline's Maintenance authority for the appropriate aircraft type.*

*i) Following a defect entry and subsequent rectification work, the 'Certificate of Release to Service' on the technical log sector sheet is to be signed by an appropriately approved engineer before the next flight.*

*ii) Following a defect entry at an airport where no authorised Air Peace Limited engineer is available, the defect may, if allowable under the MEL, be transferred by the Captain to the ADD Log of the aircraft technical log. If the defect is not one allowable under the MEL, the captain is to inform Operations Control of the problem, together with a contact number, and await further instructions. Operations Control will contact the Duty Engineer and it follows that the Captain must remain available for*

*subsequent contact and advice by the Duty Engineer.*

### **1.17.1.3 Excerpts from Air Peace Operations Manual (OM PART B)**

*3.11 REJECTED TAKE - OFF (RTO)*

#### *3.11.1 Procedures for All runways*

*Below 80 kts, either pilot may command the stop for any significant failure. This is because the aircraft has relatively low energy and the risk of a runway excursion is negligible. In this event, the captain retains the thrust levers and applies the brakes to bring the aircraft to a halt, and the right-seat pilot retains the control column. Above 80 kts, the FO must only command a stop for a potential runway blockage or a control malfunction. For any other malfunction the FO must announce it to the Captain who will make the clear decision to stop or to continue the take-off. This is because the aircraft has high energy, and the risk of Excursion increases as the aircraft approaches V1. If it is the RHS Pilot handling the aircraft and the decision to stop occurs above 80kts, the LHS Pilot will automatically take control. The take-off should be abandoned by retarding the Thrust Levers. For any other indication, the Captain may call "Stop, Stop" if he considers the safety of the aircraft is in doubt. If he considers it safer to continue he must call "GO". The acceleration rate of the aircraft (3 – 5 kts per sec) means that the decision to stop must be taken, and action to stop the aircraft must be initiated, by V1, otherwise stopping the aircraft within the runway is not guaranteed. Following an engine failure below V1 the take off MUST be rejected because the aircraft may not be capable of achieving flight before the end of the runway. Pilots must be vigilant on every take-off and alert for the unexpected. Pilots are advised that a burst tyre on take off will significantly increase the distance in which the aircraft can be stopped. Therefore it is recommended that in this situation the take off is continued if it occurs above 80 kts.*

*Caution: With a shredded tyre, retracting the gear after take-off could be unwise subject to climb out performance considerations.*

*Following a RTO a further take-off may be made without inspection of the brakes and wheels provided:*

*λ The RTO occurred before 80 kts*

*λ The cause of the RTO is positively identified and corrective action taken*

*λ All relevant checklists are repeated*

*λ Brake temperatures are in the normal range*

*If these conditions are not met the aircraft must be returned to stand for maintenance inspection.*

### *3.11.2 Aircraft Handling on RTO*

*For all Take-offs, the LP will guard the Thrust levers. Following a call of "Stop, Stop [I have control]" the LP should pull both Thrust Levers to idle whilst simultaneously applying maximum appropriate anti-skid braking.*

*The RP Calls:*

*a. "Spoilers OPEN"*

*b. Speed Calls every 10 kts decreasing*

*c. "900 m" - alternating red and white centreline lights*

*d. "300 m" - all red centreline lights*

*The RP should then advise ATC that the aircraft is rejecting and if appropriate that a fire warning is indicated. ATC should be asked if they can see any evidence of fire from the tower. In the event of a fire or situation that may deteriorate (brake fire, fluid leakage), the aircraft should be stopped on the Runway and parked in an appropriate direction to position the fire downwind, followed by a review of the failure and appropriate actions.*

*The Cabin Crew should be contacted by use of the Cabin Emergency Button at an appropriate time within 15 seconds of coming to rest. Crews should be alert to the potential for Brake Overheat conditions that may lead to fire and therefore should monitor the Hydraulics page.*



#### **1.17.1.4 Air peace Maintenance Procedures**

##### **1.17.1.4.1 Excerpts from EMB145 Approved Maintenance Manual (AMM) 1124 Hydraulics System Reservoir Servicing/Replenishment**

The EMB145 approved maintenance manual AMM1124 for hydraulic system reservoir servicing/replenishment states the following:

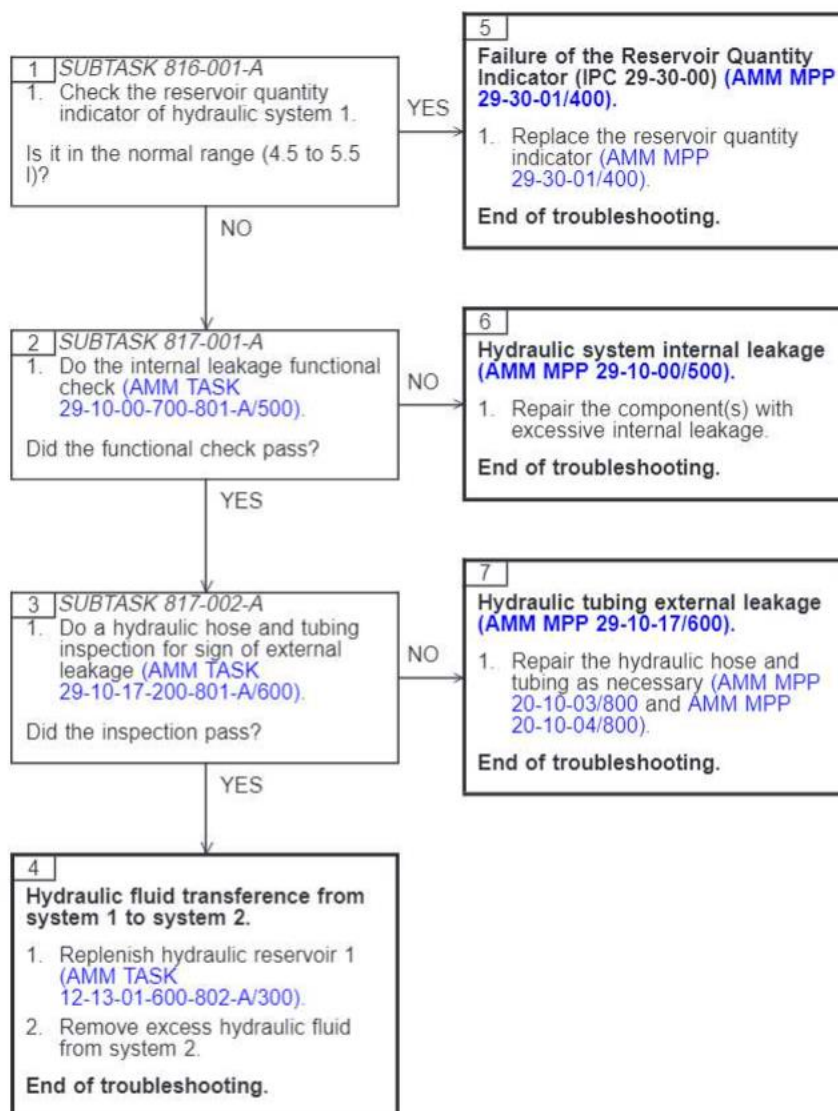
- a) The procedures to check the level of the fluid in the hydraulic system reservoir. Also, gives the procedures to fill the reservoir.
- b) The fluid used to service the hydraulic system must be referred in AMM MPP 20-30-01/200.
- c) The procedure in this section are giving in the sequence below.

Task number: 12-13-01-600-801-A (HYDRAULIC SYSTEM RESERVOIR-FLU-ALL ID LEVEL CHECK

Task number: 12-13-01-600-802-A (HYDRAULIC SYSTEM RESERVOIR-RE-ALL PLENISHMENT)

As per AMM1124 (12-13-01-600-802-A) below is a troubleshooting procedure for hydraulic system low quantity indication.

## BLOCK DIAGRAM INDICATING TROUBLESHOOTING STAGES FOR HYDRAULIC SYSTEM LOW QUANTITY



### 1.17.2 Nigerian Civil Aviation Authority (NCAA)

NCAA is the government agency saddled with the regulation and oversight of aviation activities in Nigeria. The NCAA is set up by the Nigerian Civil Aviation Act (2006) which enables the Director General of NCAA to make regulations in aviation. The current regulations are as enshrined in the Nigeria Civil Aviation Regulations (Nig. CARs) 2015.

Relevant sections of the Nig. CARs guide activities of personnel and service providers in the aviation industry. Oversight activities are achieved by continuous and periodic audits by inspectors of the NCAA.

### **1.17.2.1 Excerpts from Nig. CARs Part 12 (Aerodromes).**

#### ***Rescue and Fire-Fighting at Aerodromes.***

*12.6.16.1. The aerodrome operator shall provide the aircraft fire-fighting vehicles and the personnel that correspond to the critical category for firefighting and published in the Aeronautical Information Publications (AIP) to respond to an aircraft emergency at the aerodrome.*

#### ***Response Test.***

*12.6.16.10.—(a) The aerodrome operator shall carry out a response test to evaluate the response time and effectiveness of the aircraft fire-fighting service required to be maintained during the hours of operation specified every 12 months ; and at any time at the request of the Authority, where the Authority has reasonable grounds to believe that the aircraft fire-fighting service at the aerodrome does not meet the requirements of this section.*

*(b) The aerodrome operator shall give the Authority at least 30 days written notice of the date on which a response test is to be carried out.*

### **NCAA All Operator Letter FSG 003:**

*ALL OPERATORS LETTER (FSG 003)*

*Ref: NCAA/FSG/AOL/19/003*

*Date: 30<sup>th</sup> July, 2019*

*To: All Aircraft Operators*

*From: Nigerian Civil Aviation Authority*

*Attn: Director of Flight Operations/Chief Pilot/Safety Manager*

*Subject: CONTINUOUS OVERWRITING OF COCKPIT VOICE (CVR) INFORMATION*

*The purpose of this FSG All Operators Letter (AOL) is to alert all aircraft operators on the continuous overwriting of Cockpit Voice Recorder (CVR) Information by their flight*

*crew members and the necessary to ensure compliance with the appropriate Nigeria Civil Aviation Regulation (Nig. CARs) requirement.*

### **Background**

*The Nigerian Civil Aviation Authority (NCAA) has modified that airline operators' flight crew members are in the practice of continuous overwriting the CVR information. This practice makes it impossible for the Accident Investigation Bureau (AIB) to retrieve actual data to aid in its investigation as required by Paragraph 25 and 26 of the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations 2019. This action had also impeded and imposed undesirable difficulty in ensuring that AIB successfully discharge its statutory mandate of investigating accidents and serious incident.*

*Nig. CARs Part 7.8.1.3 (b), which is derived from the provisions of ICAO Annex 6, Section 11.6 states that, "To preserve flight recorder records, flight recorders shall be deactivated upon completion of flight time following an accident or incident. The flight recorders shall not be reactivated before their disposition as determined in accordance with the accident/incident regulation of Nigeria.*

*Furthermore, Nig. CARs Part 8.14.10.3 (a) requires that "The operator/owner of the aircraft, or in the case where it is leased, the lessee, shall ensure, to the extent possible, in the event the aircraft becomes involved in an accident or incident, the preservation of all related flight recorders records and, if necessary, the associated flight recorders, and their retention in safe custody pending their disposition as determined by the Accident Investigation Bureau.*

*The Operator requirement of the flight recorders by the flight crew as detailed in Nig. CARs. Part 8.5.1.24(b) and (c) require that "The PIC may not permit a flight data recorder or cockpit voice recorder to be disabled, switched off or erased during flight unless necessary to preserve the data for an accident or incident investigation" and "In event of an accident or incident the PIC shall act to preserve the recorded data for subsequent investigation upon completion of flight" respectively.*

**Action Required:**

*All operators of aircraft with CVR installed are hereby required to:*

*Conduct in-house awareness training for their flight crews on their flight crews on the requirement of Nig. CARs Part 7.8.1.3 (b), 8.14.10.3 (a) and 8.5.1.24 (b) and (c) immediately on receipt of this AOL;*

*Develop/Emphasize appropriate procedure addressing the requirements of Nig. CARs 7.8.1.3 (b), 8.14.10.3 (a) and 8.5.1.24 (b) and (c) and incorporate same in their respective Operations Manual. This amendment must be submitted to the Authority for review, acceptance and approval within thirty (30) days from the date of issue of this AOL. These procedures must form part of the contents of the indoctrination training for flight crew members; and*

*Ensure continuous compliance with the requirement of Nig. CARs on the preservation of flight recorder records.*

*The Authority will apply its enforcement process, where non-compliances to the requirements of the Nig. CARs or non-conformance to the operator's approved procedures have been noticed.*

**1.17.3 Federal Airports Authority of Nigeria (FAAN)**

FAAN is a service organization established by CAP F5 FAAN establishment Act, Laws of Federation of Nigeria 2004. It is statutorily charged with the responsibility to manage all Commercial Airports in Nigeria and provide service to both passenger and cargo airlines. Generally, to create conditions for the development in the most economic and efficient manner of air transport and the services connected with it. Also, to develop and provide facilities such as terminal building(s), taxiway(s), runway(s), etc for airports within Nigeria.

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## **Excerpts from Airport Emergency Plan Manual: Kaduna International Airport**

### *1.3.4 Aerodrome Emergency Plan (AEP) Authorisation*

*The AEP shall be issued under the authority of the Airport Manager, Kaduna International Airport and coordinated by the Head of Department, Safety Services, who ensures that AEP is maintained. Whenever an amendment to the AEP is issued, a copy will be provided to the manual controller.*

### *1.6 Emergency Exercises*

*The adopted three methods of testing the Airport Emergency Plan are:*

- a. Full-scale exercises;*
- b. Partial exercises;*
- c. Tabletop exercises.*

#### *1.6.1 Testing of Airport Emergency plan*

*The AEP shall be tested by conducting:*

- a. A full scale aerodrome emergency exercises at interval not exceeding two years.*
- b. Partial emergency exercises in the intervening years.*
- c. A series of modular tests commencing in the first year and concluding in a full-scale aerodrome emergency exercise at intervals not exceeding three years; and reviewed thereafter, or after an actual emergency, so as to correct any deficiency found during such exercises or actual emergency.*
- d. The plan also observes human factor principles and team coordination in testing, organization and participation of all agencies through Mutual Aid Agreement, regular meetings and enlightenment, compensation to experts and specialist equipment that may be used.*

## **1.18 Additional information**

### **1.18.1 Excerpts from Civil Aviation (Investigation of Air Accidents and Incidents) Regulations, 2019**

#### *Protection of evidence, custody and removal of damaged aircraft*

*19.—(1) Where an accident or a serious incident occurs in Nigeria, the Bureau shall take all reasonable measures to protect the evidence and to maintain safe custody of the aircraft and its contents for such a period as may be necessary for the purposes of an investigation. Protection of evidence shall include the preservation, by photographic or other means of any evidence which might be removed, effaced, lost or destroyed. Safe custody shall include protection against further damage, access by unauthorized persons, pilfering and deterioration.*

*2.—(a) No person other than the Commissioner, the investigator-in-charge or an authorized person shall have access to the aircraft involved in the accident or serious incident, the contents thereof, or the site of the accident or serious incident; and (b) No person shall move or interfere with the aircraft, its contents or the site of the accident or serious incident except under the authority of the commissioner or the investigator-in-charge.*

*3. Notwithstanding Sub-paragraph 19.1 above:*

*(a) The aircraft involved in an accident or serious incident may be removed or interfered with to such extent as may be necessary for all or any of the following purposes:*

*(i) extricating persons or animals;*

*(ii) removing any mail, valuables or dangerous goods carried by the aircraft for the purpose of preservation;*

*(iii) preventing destruction by fire or other cause;*

*(iv) preventing any danger or obstruction to the public, air navigation or other transport; or*

*(b) if an aircraft is wrecked in water, the aircraft or any contents thereof may be*

*removed to such extent as may be necessary for bringing the aircraft or its contents to a place of safety.*

*4. Where the Commissioner or investigator-in-charge has authorized any person to remove any goods or passenger baggage from the aircraft or to release any goods or passenger baggage from the custody of the Commissioner or investigator-in-charge, the person may*

*(a) remove the goods or passenger baggage or any other property from the aircraft under the supervision of a Police Officer not below the rank of an Assistant Superintendent of Police (ASP);*

*(b) release the goods or passenger baggage from the custody of the Commissioner or investigator-in-charge, subject to clearance by or with the consent of the Nigeria Custom Service, if the aircraft has come from a place outside Nigeria.*

### **1.18.2 Human factors in flight operations**

Human factors issues, specifically human errors, contribute to more aircraft incidents and accidents than any other single factor. Human errors include errors by the flight crew, maintenance personnel, air traffic controllers, and others who have a direct impact on flight safety.

Human factors are significant contributors in approximately 70 percent of all accidents and incidents. In a review of several databases, the committee found values in the range of 60 percent to 85 percent. These differences do not reflect on the integrity of the databases; they reflect the databases' different purposes and the understandable difficulties that arise from the substantial overlap of environmental, equipment, and human factors issues. This overlap, is intrinsic to a complex system with a large number of possible accident and incident sources (primary and contributory). There is no clear way, and indeed no practical need, to separate entirely environmental from operational factors.

Inaccurate situational awareness by the flight crew can arise in several different ways. Some examples are listed below:



- The flight crew may not have critical data necessary to adequately define its situation, which may lead to inappropriate decisions and, ultimately, an accident.
- The flight crew may have the data it needs but misinterpret the data.
- The flight crew may have the data it needs, properly interpret the data, and accurately define the situation, but it may not have the training, skills, or procedures to make proper decisions or to carry them out in the time available.

Source: Improving the Continued Airworthiness of Civil Aircraft: A strategy for the FAA's Aircraft Certification Service (1998)

### **1.18.3 Confirmation bias**

Once an initial understanding (mental model) has been formed, the individual will search his/her memory and the immediate situation for additional data relevant to that mental model. Such data, then, are apt to be recalled and regarded as pertinent only to the extent that they confirm the mental model at hand. Although potentially confirmatory information tends to be taken at face value, potentially disconfirming information is subjected to a more critical and sceptical scrutiny.

Several studies have shown that preliminary hypotheses formed on the basis of ambiguous data interfere with the later interpretation of better, more abundant data (*Lewis and Normal, 1986*). An individual's mental model of a situation is likely to correspond to a large part to the reality, even though it may be wrong in some respects. Having expectations frequently confirmed reduces the sensitivity of the error detection mechanism. Confirmation bias is a selective process that favours information relevant to the presently held view. In essence it is a bias towards relevant-appearing information. Additionally acting upon one's beliefs can also increase the psychological costs or "*dissonance*" involved in changing one's beliefs (*Festinger, 1957*).

Confirmation bias can have such a strong impact that once individuals have developed a mental model of a problem space, and they have confirmed their model, it becomes

very difficult to let go of the model, even in the light of contradictory information. The need for a realignment of one's mental model becomes apparent only in the light of one or more extraordinary events that do not fit the model.

Source: [https://www.skybrary.aero/index.php/Confirmation\\_Bias](https://www.skybrary.aero/index.php/Confirmation_Bias)

#### **1.18.4 Plan Continuation Bias**

One specific form of confirmation bias is (plan) continuation bias, or plan continuation error. Once a plan is made and committed to, it becomes increasingly difficult for stimuli or conditions in the environment to be recognized as necessitating a change to the plan. Often, as workload increases, the stimuli or conditions will appear obvious to people external to the situation; however, it can be very difficult for a pilot caught up in the plan to recognize the saliency of the cues and the need to alter the plan.

When continuation bias interferes with the pilot's ability to detect important cues, or if the pilot fails to recognize the implications of those cues, breakdowns in situational awareness (SA) occur. These breakdowns in SA can result in non-optimal decisions being made, which could compromise safety.

Source: [https://www.skybrary.aero/index.php/Continuation\\_Bias](https://www.skybrary.aero/index.php/Continuation_Bias)

#### **1.18.5 High Speed Rejected Take-off**

Whilst a successful rejection of take-off from  $V_1$  is achievable in all but exceptional and very specific cases (see below), it is universally recognised that the closer the speed gets to  $V_1$ , the greater the risk involved in a decision to stop. Therefore, once at high speed, it is usually specified that the take-off will only be rejected for major malfunctions such as an engine failure or fire - or at the discretion of the pilot in command in the event that a similarly serious situation is perceived. In many modern aircraft types, the annunciation of non-critical alerts during the high speed part of the take-off roll and in initial climb is inhibited to preclude unnecessary distraction.

Source: [https://www.skybrary.aero/index.php/Rejected\\_Take\\_Off](https://www.skybrary.aero/index.php/Rejected_Take_Off)

## **2.0 Analysis**

### **2.1 General**

This analysis focuses on the conduct of the flight, human factor elements (Confirmation Bias), sequence of events during the rejected take-off and Air Peace Limited EMB 145LR hydraulic fluid replenishment practice. It also covers the preservation of evidence and ARFFS response. Weather was not considered a factor in this occurrence.

### **2.2 Conduct of the flight**

#### **2.2.1 Introduction**

The aircraft was scheduled to operate four sectors. The first two sectors were accomplished without any reportable incident. During climb out of Lagos on the third sector, an advisory light indicating HYD1 LO QTY on the Engine Indicating and Crew Alert System (EICAS) came ON and the Quick Reference Handbook (QRH) section 10-7 (HYDRAULIC SYSTEM LOW QUANTITY) was accomplished. The hydraulic level was monitored until landing Kaduna.

The HYD1 LO QTY is an indication that the hydraulic fluid in the reservoir had gone below one litre, thus indicating that Hydraulic System 1 lost more than five litres in just two sectors of less than one hour duration each. Although the QRH advised that the crew should monitor the hydraulic system, but the EICAS alert is indicating that the hydraulic quantity is less than 1 litre in a reservoir that has a maximum quantity of 6 litres, this would have prompted the crew to consider initiating an air return to its maintenance base (the departure aerodrome), instead of continuing the flight to Kaduna.

After landing Kaduna, as the aircraft turned to exit the active runway, there was slight stiffness of the Nose Wheel Steering (NWS) and the Electric Motor Driven Pump

(EMDP 1) switch was put in the ON position. The NWS became more effective. The aircraft taxied to the ramp where passengers disembarked.

The stiffness of the tiller should have also heightened the crew alertness for maintenance action to be carried out immediately after parking at the apron. The crew could have adequately assessed the situation and made an informed decision.

The fault (HYD1 LOW QTY) encountered in the sector was not entered in the technical logbook and thus the duplicate (green) copy required to be deposited at the Kaduna station was not kept as per the requirement of Air Peace Limited (APL) Operations Manual Part A Chapter 8.1.11.2.5(c) and 8.1.11.2 respectively.

### **2.2.2 Kaduna-Lagos sector**

Air Peace Limited (APL) Operations Manual Part A Chapter 8.1.11.2.5(a) requires that faults like HYD1 LO QTY be reported to the Operations Control which will in turn contact the Duty Engineer. In the meantime, the flight crew is required to await further instructions. However, upon completing the flight while on ground Kaduna airport, the crew did not make recourse to the airline's Operations Control Centre to report the HYD1 LO QTY for appropriate maintenance advice. Thus, the requirements of APL Operations Manual Part A Chapter 8.1.11.2.5(a) were not fulfilled. Also, an aircraft is considered to be airworthy when equipped, maintained and operated in accordance with the provisions of Nig. CARs and the pertinent operating limitations. It is in view of the foregoing that the investigation considers the aircraft not serviceable and hence should not have been released for the Kaduna-Lagos sector.

APL Operations Manual Part A 1.5.1.3 (h) (ii) requires only a crewmember to perform the transit checks but due to the HYD1 LO QTY (system one hydraulic low quantity) indication observed during the flight, the crew decided to do a double pre-flight inspection whilst preparing for the next sector (Kaduna-Lagos). This practice, although seemingly cautious, falls short of the mandatory requirement of reporting to Operations Control Centre of the airline. In addition, the location of the source of the

hydraulic leakage was obscured by panels that can only be accessed by maintenance personnel, as the flight crew have limited access during pre-flight inspection.

The AFTER START Checklist requires that the Electric Motor Driven Pump (EMDP) be in the AUTO position. However, the flight crew decided to turn the EMDP ON due to lack of hydraulic fluid in the system. The flight crew referred to the QRH and erroneously assumed that the "MONITOR" provision therein was applicable to the situation even though the aircraft was not airborne. In addition, the ineffectiveness of the EDP earlier noted was more likely a result of the depleted hydraulic fluid, and as such the EMDP 1 would eventually fail if the reservoir was not replenished.

Recall that the Hydraulic System 1 is fitted with a priority valve that isolates the landing gear when the EMDP 1 is supplying the system. The flight crew did not take into account that the operation of EMDP 1 would activate the priority valve and in effect the landing gears would not be retracted after take-off.

The Lead Cabin Crew informed the flight crew that there was an unusual sound from the over wing to the aft of the aircraft. The flight crew concluded that the sound emanated from the EMDP 1. Having concluded that the operation of the EMDP 1 was the likely source of the sound, further caution should have been employed by discontinuing the flight. However, the flight proceeded despite another call from the cabin crew alerting the flight crew.

The operation of the EMDP 1 with a nearly depleted hydraulic reservoir likely caused the unusual noise reported from the cabin, as the EMDP 1 is located in the general area described by the cabin crew.

The possibility of a rejected take-off due to abnormal conditions like tyre burst and engine failure were also not fully appreciated. If so, the likelihood of not achieving desired braking and thrust reverser functionalities with an unserviceable hydraulic system would have called for a discontinuation of the flight.

Upon line up for take-off, the flight crew observed that all engine instrument indications were normal. However, this observation was not sufficient for the flight

crew to decide to continue with the take-off since the fault encountered previously was related to the hydraulic system and not the engine.

### **2.3 Human factors element**

During taxi for departure, the flight crew observed the HYD 1 E PUMP FAIL and interpreted the message to mean that the hydraulic system did not fail as HYD 1 SYS FAIL (hydraulic system one fail message) was not seen on the EICAS. However, this was an erroneous conclusion because the HYD 1 SYS FAIL was not observed due to residual hydraulic pressure on the EMDP pressure line. This could be a case of confirmation bias. The flight crew came to a conclusion that the hydraulic system had not failed and that the provision of the QRH section 10-7 (HYDRAULIC SYSTEM LOW QUANTITY) is to be applied.

Another likely instance of confirmation bias is when the flight crew decided to proceed with the flight to Lagos after a double walk-around (visual inspection) outside the aircraft while ignoring the fact that there was a chance of a fluid leakage being in a location that could not be readily observed without opening panels of the aircraft.

These and the fact that the aircraft landed safely in Kaduna with the flight crew monitoring the situation further reinforced the flight crew decision to continue to Lagos (plan continuation bias) and use the same QRH provision that was used in the earlier flight.

### **2.4 Sequence of events during the rejected take-off**

As the aircraft accelerated towards 119 kt, the take-off was rejected thus initiating a sequence of events that eventually led to the failure of numbers 1 and 2 wheel assemblies and additional damages to the aircraft.

Upon selecting the hydraulic system page on the EICAS, the system was monitored during take-off. Items on the page include system 1 hydraulic fluid level (which was already low) and system 1 hydraulic pressure. The FDR indicated that the hydraulic pressure was normal at the time the take-off was aborted (i.e. when the thrust reversers were retarded) and became low afterwards. However, hydraulic quantity indication was not recorded on the FDR and the CVR did not pick up any aural warning at the instance prior to the rejection of take-off. Considering that the hydraulic system 1 on the EICAS was already showing low hydraulic quantity due to inadequate fluid quantity, although the system pressure was still normal, this could be the reason for the rejected take-off.

Information obtained from the FDR indicated that the take-off was rejected at about 582 m from the starting point. This was done by retarding the thrust levers, applying brake pressure and deploying the thrust reversers (TR). TR 1 did not deploy due to the failure of Hydraulic System 1 caused by the depletion of the hydraulic fluid. This also affected the outboard wheels (wheels number 1 and 4) which are powered by the hydraulic system 1.

Post occurrence inspection showed that there was flat spot on the number 2 tyre, this could be due to tyre number 2 and 3 being connected to the functional hydraulic system (Hydraulic System 2).

The failure of number 2 tyre transferred the shared weight of the aircraft to number 1 tyre hence causing its eventual failure at about 1300 m from the point where tyre number 2 failed as evidenced by marks on the runway.

The failure of both wheels caused the aircraft to move in a ground loop as evidenced by the witness marks (due to metal to runway surface contact) on the runway. This was further exacerbated by the asymmetric thrust reverser deployment.

The aircraft finally stopped 284 m to the end of RWY 05.

## **2.5 Air Peace Limited EMB 145 hydraulic fluid replenishment practice**

APL maintenance job card JC No.: E145001APL-EMB allows for the recording of the daily inspections carried out on the Embraer 145LR. Item number 2 on the job card is

the check on the Hydraulic System 1 and 2 reservoirs. The job card requires that a refill be carried out if any of the reservoirs is below the full mark. In addition, the amount refilled should be recorded if it exceeds one litre (1.057 quarts).

On 13th January 2021, the night prior to the day of the occurrence, five (5) quarts (4.73 litres) of hydraulic fluid was refilled into both hydraulic systems' reservoirs. The record on the Job Card does not indicate the quantity of hydraulic fluid refilled into either of the two reservoirs. Therefore, determining which of the two hydraulic systems that experienced excessive consumption of the hydraulic fluid recorded becomes practically impossible in this instance.

However, the quantity of hydraulic fluid replenished in the above instance, being roughly a third of the combined capacity of both hydraulic systems' reservoirs, could be sufficient to trigger suspicion that some significant leak of hydraulic fluid was likely occurring in either or both hydraulic systems. This should have called for a thorough assessment by the maintenance unit to identify the source of the leakage.

### **2.5.1 Post occurrence assessments and maintenance actions**

The post occurrence assessment and maintenance action conducted on 5N-BVD showed that a pressure switch was found loose, the switch connector was retightened but the HYD1 LOW QTY indication came ON again as the aircraft was being ferried from Kaduna to Lagos. Investigation revealed that further assessment was carried out at the company's maintenance base in Lagos, and a union on the brake control valve of the hydraulic system 1 pressure line was found loose thus causing the leakage that was found on zone 156 of the fuselage. Both the pressure switch and the loose union were retightened, and a test flight was conducted successfully.

### **2.6 Preservation of evidence**

The preservation of an accident or incident site is very important as it enables investigators to gather relevant and crucial evidence that can aid in the investigation of the occurrence. Section 19 of the Civil Aviation (Investigation of Air Accidents and



Incidents) Regulations, 2019 (Protection of evidence, custody and removal of damaged aircraft) prohibits unauthorized access to an accident/incident site, the aircraft, its content or tampering with the wreckage and evidence thereof.

In light of the above, it is important that all evidence are properly documented, taking into account the size, nature and location of recovery. It could be recalled that the incident site was compromised as debris were removed by unauthorised persons and there was no appropriate documentation of the evidence. In addition, the contents of the aircraft, including the baggage were removed under same circumstances. In effect, this deprived the investigation the opportunity to independently verify the actual weight of the aircraft.

Following a spate of incidences where the Cockpit Voice Recorders (CVR) were overwritten, the NCAA issued an All-Operators Letter (NCAA/FSG/AOL/19/003) reiterating that operators as a matter of responsibility should protect the vital contents of the CVR. Notwithstanding, significant portions of the CVR recordings were overwritten as the CVR was not deactivated, thus making it difficult to reconstruct significant portions of the Lagos-Kaduna flight (sector).

## **2.7 Aerodrome Rescue and Fire Fighting Services (ARFFS) Response at Kaduna airport**

The ARFFS reported that as the aircraft was on take-off roll, a dust cloud was observed rising from underneath the aircraft as the aircraft speed bled considerably. At this time, the ATC enquired from APK7377 if there was any problem and the crew requested ARFFS assistance to ascertain the condition of the aircraft. ARFFS was then dispatched to the scene.

Information available to the investigation indicated that the ARFFS arrived four minutes 11 seconds after the ATC call as against the provision in ICAO's doc.9137-AN/898 part 1 (Airport Services Manual-Rescue and Fire Fighting); two minutes and not exceeding three minutes to the end of each runway as well as to any other part of

the movement area in optimum conditions of visibility and surface conditions. The delay in arrival could have been as a result of the late observation of the distress situation by the ATC and ARFFS, owing to the limited view offered by the watch room. Recall that the ATC was co-located with the ARFFS watch-room which had a limited view of the airside at the time of this occurrence.

The Nig. CARs 12.6.16.10 requires the aerodrome operator to carry out response test to evaluate the response time and effectiveness of the aircraft fire-fighting service required to be maintained during the hours of operation specified every 12 months. This would enable the ARFFS to identify impediments towards achieving the desired response in emergency situations. Records indicate that the last test/mock exercise conducted was in July 2018, two years prior to this occurrence.

In addition, the unserviceability of one of the fire-fighting tenders can grossly undermine the fire-fighting capability of the station especially during emergencies. This could have been readily identified if the Aerodrome Emergency Plan was tested as and when due in line with section 1.3.4 of the Emergency Plan Manual for Kaduna airport (Aerodrome Emergency Plan (AEP) Authorisation).

## **3.0 CONCLUSION**

### **3.1 Findings**

1. The pilots were qualified and certified to conduct the flight.
2. On 13th January 2021, five (5) quarts (4.73 litres) of hydraulic fluid was refilled into the hydraulic system reservoirs during post flight inspection in Lagos, the night prior to the day of the occurrence.
3. The HYD1 LO QTY indication on the Engine Indicating and Crew Alerting System (EICAS) came ON during climb out of Lagos.
4. The flight crew checked Section 10-7 (HYDRAULIC SYSTEM LOW QUANTITY) of the EMB145 Quick Reference Handbook (QRH) which recommended that the affected system be monitored.
5. The flight crew monitored the Hydraulic System 1 quantity on the Multi-Function Display (MFD) up to safe landing Kaduna.
6. After landing in Kaduna, the Pilot noticed slight stiffness on the Nose Wheel Steering (NWS) while exiting the active runway to the ramp.
7. The Pilot instructed the Co-Pilot to select the Hydraulic System 1 Electric Motor Driven Pump switch from AUTO to ON position. Thereafter, the Nose Wheel Steering became more effective.
8. On ground Kaduna, the flight crew separately conducted walk-around and reported no sign of hydraulic fluid leakage around the aircraft.
9. No technical logbook entry on the HYD1 LO QTY was made on ground Kaduna.
10. The HYD1 LO QTY indication was not reported to the Air Peace Operations Control Centre for technical advice while on ground Kaduna.

11. During taxi out for departure from Kaduna, the Pilot instructed that the Hydraulic System 1 Electric Motor Driven Pump switch be selected to ON position from AUTO.
12. The Lead Cabin Crew reported twice to the flight crew via the intercom that he heard noise from the rear of the aircraft while taxiing out.
13. After line-up, the flight crew checked the engine parameters and noticed that there was no abnormal indication.
14. During the take-off roll, at a speed of 119 kt the Pilot took over the control of the aircraft and performed a high-speed rejected take-off.
15. The Pilot applied foot brakes and thrust reversers, the Number 1 Thrust Reverser did not deploy.
16. The aircraft moved in a ground loop before finally coming to a stop 284 m to the end of RWY 05, four meters to the left of centreline of the runway.
17. After the high speed rejected take-off, the engines were shut down but the APU was left running and the CVR was not deactivated. Some portions of the CVR recordings relevant to this occurrence were overwritten.
18. The Aerodrome Rescue and Fire Fighting Services (ARFFS) arrived four minutes and 11 seconds after notification by ATC.
19. The Kaduna ATC tower was co-located with the ARFFS watch-room at the time of the occurrence.
20. The watch room has a limited viewing of the end of runway 05.
21. The last Aerodrome Emergency Plan simulation/Response Time test conducted for Kaduna airport was in July 2018, two years prior to this occurrence.
22. Kaduna Airport did not have an approved Airport Emergency Plan at the time of this occurrence.

23. Hydraulic fluid level indicator for System 1 Reservoir showed fluid quantity was below one litre (1.057 quarts) during post occurrence inspection.

24. A loose coupling on the hydraulic line servicing the Brake Control Valve on the Hydraulic System 1 line was eventually found on 19th January 2021 as the source of the large amount of hydraulic fluid loss.

### **3.2 Causal factor**

Operating the aircraft with an unserviceable hydraulic system leading to a high speed rejected take-off.

### **3.3 Contributory factors**

1. Leakage of hydraulic fluid from Hydraulic System 1 due to a loose coupling on the hydraulic line servicing the brake control valve.
2. Non-adherence to Air Peace Limited company guidelines on diagnosis and reporting of faults.
3. The Non-indication of a hydraulic leakage and Non-annunciation of Hydraulic system fail message on the Engine Indicating and Crew Alerting System (EICAS) reinforced the flight crew decision (confirmation bias) to continue with the flight from Kaduna.

## **4.0 Safety recommendations**

### **4.1 Safety recommendation 2024-004**

Air Peace Limited should ensure that flight crew adhere to requirements of Operations Manual Part A Chapter 8.1.11.2.5 (a) vis-a-vis making entries in the technical log book.

### **4.2 Safety recommendation 2024-005**

Air Peace should ensure that faults that are recorded in the Job card are also recorded in the technical log book.

### **4.3 Safety recommendation 2024-006**

Air Peace Limited should ensure that flight crew adhere to requirements of Operations Manual Part A Chapter 8.1.11.2.5 (c) vis-à-vis reporting malfunctions and technical fault(s) encountered during flight to the Operations Control Centre.

### **4.4 Safety recommendation 2024-007**

Air Peace Limited should improve its internal oversight of its maintenance procedures such that trends of excessive hydraulic fluid depletion could be timely identified and remedied.

#### **4.5 Safety recommendation 2024-008**

Nigerian Civil Aviation Authority should ensure that Air Peace Limited and other operators adhere to the provisions of Nig. CARs 7.8.1.3(b) and the ALL OPERATORS LETTER (FSG 003) as regards training flight crew on the need to preserve the contents of the Cockpit Voice Recorder after reportable incidences are observed.

#### **4.6 Safety recommendation 2024-009**

Nigerian Civil Aviation Authority should ensure that operators comply strictly with the provisions of All Operators Letter (FSG 003) Ref: NCAA/FSG/AOL/19/003 that states: All operators of aircraft with CVR installed conduct in-house awareness training for their flight crews on the requirement of Nig. CARs Part 7.8.1.3 (b), 8.14.10.3 (a) and 8.5.1.24 (b) and (c).

#### **4.7 Safety recommendation 2024-010**

Nigerian Civil Aviation Authority should ensure that Kaduna airport AEP is approved and mock drills are carried out as required by the Nig. CARs Part 12.6.16.10 (Rescue and Fire-Fighting at Aerodromes).

#### **4.8 Safety recommendation 2024-011**

Nigerian Airspace Management Agency (NAMA) should ensure a serviceable Control Tower is reconstructed at Kaduna airport.

#### **4.9 Safety recommendation 2022-012**

Federal Airport Authority of Nigeria should ensure that its staff adhere strictly to the Provisions of Civil Aviation (Investigation of Air Accidents and Incidents) Regulations, 2019 Part 3 (General) Article 19 (Protection of evidence, custody, and removal of damaged aircraft).

#### **4.10 Safety recommendation 2024-013**

Federal Airport Authority of Nigeria (FAAN) should ensure that occurrences are duly reported, perishable evidence protected and appropriately documented until the arrival of the Air Safety Investigators to the occurrence site in line with regulation 19 of the Civil Aviation (Investigation of Air Accidents and Incidents) Regulations, 2019.



# APPENDICES

## Appendix 1: Load sheet



No 7029784

Dest	Passengers			Load	
	M	A/F	Ch	Inf	Total
					Tr
					B
					C
					M
					Tr
					B
					C
					M
Total					650

Passengers → + 3696  
 Total Traffic = 4346

Dry Operating Mass (+500 Kgs) + 12678  
 Extra Crew + 7022  
 Zero Fuel Mass = 17900 LMC ±  
 Max 17900  
 Zero Fuel Mass (after LMC) = 17900  
 Take-Off Fuel + 3100  
 Take-Off Mass = 20100 LMC ±  
 Max 20100  
 Take-Off Mass (after LMC) = 20100  
 Trip Fuel = 1400  
 Landing Mass = 18700 LMC ±  
 Max 18700  
 Landing Mass (after LMC) = 18700

Cabin A	From	Original	Address	Flight	A/C Reg
Pax	KAO	KAO		14/07/21	5N-BVD
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					

Maximum Mass for:	Zero Fuel	Take-Off	Landing
Take-off Fuel +	17900	20100	18700
Lowest TOM =	21000	22000	20200
DOM + T/O Fuel =			19276
Allowed Traffic =			4346
Total Traffic =			4346
Underload =			520

Alternate	PT
EET	0700
Endurance	0330

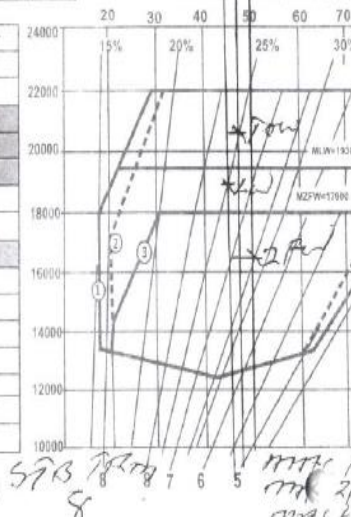
C1 Hold Mass (Kgs) and Index					
Mass (Kg)	Index	Mass (Kg)	Index	Mass (Kg)	Index
40	2	440	17	840	32
80	3	480	18	880	33
120	5	520	20	920	35
160	8	560	21	960	36
200	8	600	23	1000	38
240	9	640	24	1040	40
280	11	680	26	1080	41
320	12	720	27	1120	43
360	14	760	29	1160	44
400	15	800	30	1200	46

Fuel Index	
Mass (Kg)	Index
500-1200	-2
2400	-3
3000	-3
3400	-3
3700	-2
4000	-2
4300	-1
4900	2
5200	4

Wardrob	Mass (Kg)
	10
	20
	30
	40
	50
	60
	70

Fuel B	Mass (Kg)
	600

Balance Calculation	Index	Index
Dry Operating Index	536	
Jump Seat (-5)		
Cabin Section A	34	
Cabin Section B	77	
Cabin Section C	27	
C1 Hold Load	23	
Wardrobe	03	
Subtotal	48	986
Zero Fuel Index		506
Take Off Fuel		03
Take-Off Index		476
Fuel Burn		02
Landing Index		456



① - TOM Limit (More than 45 Pax) ② - TOM Limit (With 45 Pax or less) ③ - Limit

## Appendix 2: Certificate of Release

Autorité compétente / Pays Competent Authority / country <b>NERIAN CIVIL AVIATION                  AUTHORITY</b>		<b>CERTIFICAT D'APPROBATION POUR REMISE EN SERVICE AERONEF</b> AIRCRAFT CERTIFICATE OF RELEASE TO SERVICE				Certificat N° Form tracking Number  20-10-14352-1
Station site agréé par l'autorité pour émettre ce certificat : Station location approved by the Authority to issue this Form :		<b>ATLANTIC                  AIR INDUSTRIES</b> MAROC HANGAR AAIM AEROPORT DE BENSLIMANE , MOROCCO				Bon de commande / Contrat Réf : Work order / contract ref :  2020 OF 011-R2 16/MAY/2020 REV1
Matriculation Registration	Numéro de série Serial number	Type Model	Heures de vol Flying hours	Cycles Cycles	Moteurs AE3007A1 Engines	APU / SN
N-BVD	145199	EMB-145 LR	41557:46	35790	SN 1 : CAE311281 SN 2 : CAE312086	SP-E0214435
Programme Approved Maintenance Program	Approved Maintenance Program: ERJ 145 MAINTENANCE PROGRAMME Approved Maintenance Program Edition : 02 Révision : 00 Date : 17-SEP-2019 Issue Amendment Date		Référence du dossier de visite Work pack Reference	Date des travaux Date of performance Beginning : 27-MAY-2020 End: 28-OCT-2020		
Travaux effectués / Work performed : PROGRAMMED SCHEDULED MAINTENANCE INSPECTION IN ACCORDANCE WITH AIR PEACE WORK PACKAGE REF WorkScope-MSN145199 20201605 INCLUDING: 1A + 2A + 3A + 4A + 5A + 1C + 2C OOP WEEKLY CHECK , DAILY CHECK , ROUTINE CHECK, ADs , AND ADDITIONAL WORKS. AIRCRAFT DIRECTIVE ADs: AD2010-06-03R1-ANAC, AD2016-03-01-ANAC AIRCRAFT BULLETIN SBs : SB 145-30-0056 STRUCTURAL REPAIRS: ETD2020-145-024554, ETD2020-145-022964.						
Prochaine Inspection Maintenance Schedule Inspection 1A is due after midnight of 28th January 2021 . or upon completion by the aircraft of 42057:46 Flying Hours, whichever is sooner.						
Observations, remarques (Dérogation / Autre) Exemption, remarks (Concession / Other) :  <b>DEFERRED ITEM LIST</b>						
Certification Pour Remise en Service Je certifie que les travaux spécifiés, sauf exceptions mentionnées, ont été exécutés en conformité avec CAR-Part 6 Nigérien et que, dans le cadre de ces travaux, l'aéronef/Équipement est considéré comme prêt à être remis en service ».						
I hereby certify that the work specified above except as otherwise noted, has been carried out in accordance with requirements as specified in the Nigerian CAR- Part 6 and the applicable aircraft Maintenance Programme and in that work, the Aircraft/Equipment is considered ready for "Release to Service".						
sous réserve de l'exécution satisfaisante du vol de contrôle — subject to the satisfactory performance of the flight test						
pour le vol de convoyage technique et dans les conditions conformes au document d'approbation associé à ce vol de convoyage ref: _____ for ferry flight and under the conditions in conformity with document of approval associated with this ferry flight ref: _____						
si nécessaire ou rayer les mentions inutiles / mark if necessary or scratch the unless mention						




5N-BVD

<b>ليبيا أويل المغرب</b> <b>Libya Oil Maroc</b> S.A.S au Capital de 49.500.000 Dirhams Siège Social : Zenith Millennium, Imm. N° 7, Lot. ATTADOUFIK - Sidi Maârouf - Casablanca Tél. : 05 22 50 94 00 / 05 22 50 95 00 - Fax : 05 22 50 95 12 à 19 Bureau de Commande R.N. Tél. : 05 22 24 90 85 / 05 22 24 94 55 - Fax : 05 22 24 04 02 Bureau de Côte Mohammedia : Tél. : 05 23 31 06 89 / 05 23 30 04 99 - C.P.P. Rabat 9614 R.C. Casa 179 - C.N.S.S. : 1927956 - T.V.A. : 801246 - Patente : 36150390 - I.F. : 01030661		N° 20955				
<b>bon de livraison</b> (DELIVERY RECEIPT) <input type="checkbox"/>		<b>bon de reprise</b> (DEFUELLING RECEIPT) <input type="checkbox"/>		<b>facture</b> (INVOICE)		
<b>SOUS - DOUANE</b> (DUTY FREE) <input checked="" type="checkbox"/>		<b>ACQUITTE</b> (DUTY PAID) <input type="checkbox"/>		AVITAILLEMENT PAR : (SERVIC (REFUELLED BY) AVITAILLE (REFUELL		
HEURES (TIME)	APPEL (CALLED AT)	DEPART DEPÔT (LEAVING DEPOT AT)	ARRIVÉE SUR AVION (ARRIVED ON A/C AT)	DEBUT PLEIN (FUELLING STARTED AT)	FIN PLEIN (FUELLING COMPLETED AT)	RETOUR (BACK TO)
				M 40	M 55	
CLIENT (CUSTOMER) NOM : ATLANTIC (NAME) AIR INDUSTRIES ADRESSE : MAROC (ADDRESS)			VOL (FLIGHT) VENANT DE : (FROM) ALLANT A : (TO) ESCALE : (NEXT STOP) N° VOL : (FLIGHT NUMBER)		APPAREIL (AIRCRAFT) TYPE : EMB 145 IMMATRICULATION : (REGISTRATION) 5N-BVD	
CARTE DE CREDIT — N° EXPIRANT LE : (VALID UP TO)		International aviation credit card (carnet)		EMISE PAR : (ISSUED BY)		
QUALITE		JET AI <input checked="" type="checkbox"/>	AVGAS <input type="checkbox"/>	Autres :	N° PIT	
COMPTEUR (METER READING)	N° VEHICULE	RF3				
	APRES PLEIN (AFTER FUELLING)	+ 9171704				
	AVANT PLEIN (BEFORE FUELLING)	+ 9169479				
	DIFFERENCE (DIFFERENCE)	+ 2225				
QUANTITE (QUANTITY) 2225 (L)		PRIX UNITAIRE (UNIT PRICE) 03, 8978		VALEUR (AMOUNT) 8674,8		
US DOLLAR	AUTRES	TAUX DE CHANGE :		MONTANT :		
REMARQUES (REMARKS) PAYE PAR CHEQUE N° 190 30734						
BAC DE SERVICE N° (TANK N°)		TEST D'EAU (WATER TEST)		LOT N° (BATCH N°)		
SUP (LIBYA)		VISA DE LA DOUANE OU DE L'AEROP (CUSTOMS OR AIRPORT APPROVA				
NOM : (NAME)		VISA : (SIGNATURE)				



5N-BVD



**AIR PEACE LIMITED**  
 ...your peace, our goal

RC: 1002344

### AIRCRAFT CERTIFICATE OF RELEASE TO SERVICE AND MAINTENANCE STATEMENT

AIRCRAFT TYPE: ..... EMB-145 ..... REG. MARK: ..... 5N-BVD.....

WORK ORDER #/REF: ...APL/BVD/20/007.....DATED:.....22-JAN-20.....

SCHEDULED MAINTENANCE /INSPECTION CHECK: 1A CHECK IAW ERJ 135/145/MP3 Issue 02 Rev 00 DATED 17<sup>TH</sup> SEPTEMBER, 2019 WAS COMPLETED ON

DATE 29-01-2020 AIRFRAME HOURS: 42354:01 AND 39294 ..... TOTAL LANDING (CYCLES)

LOCATION WHERE CHECK WAS COMPLETED ..... LAGOS.....

It is hereby certified that [REDACTED] in accordance with the requirements of Nigerian CARs- Part 9 and the appropriate aircraft maintenance regulations that work, the Aircraft/Equipment is considered ready for "Release to Service".

REMARK (IF ANY) ..... NTL .....

SIGNED: ..... TURII PIKHAILENKO .....  
 (PRINT NAME OF CERTIFYING STAFF)

LICENCE NO, STAMP: UA66.0157 ..... DATE: 29/01/2020 .....  
 (APPROVED CERTIFYING STAFF)

NAME OF THE Nigerian CAR - Part 9 ORGANIZATION: ..... AIR PEACE LIMITED .....

NCAA APPROVAL REFERENCE NO: ..... REF NCAA/DAWS/AD1103/VOL.8/34.....

AIRPLANE OWNED BY: ..... AIR PEACE LIMITED .....

The next Schedule Maintenance Inspection (3A CHECK) is due after midnight of... 2<sup>ND</sup> MAY, 2020... or upon completion of the aircraft of ... 41971.3..... Flying Hours, whichever is sooner.

The following 'out of phase' Inspections/components changes are due before the next scheduled Maintenance Inspection specified above.

PART NO	S/NO	ITEMS DESCRIPTION	DUE	
			HOURS	DATE
		MAIN BATTERY SERVICING	N/A	10 MAR, 2020
		STARTER GENERATOR REPLACEMENT	N/A	21 FEB, 2020
		PORTABLE FIREX WEIGHT CHECK	N/A	09MAR, 2020

PREPARED BY (NAME) ..... PATRICIA UMUNNAH ..... SIGNATURE: [REDACTED]



5N-BVD


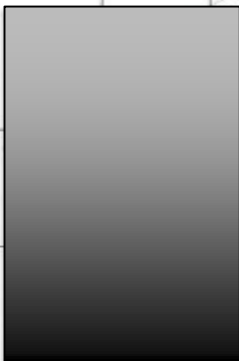
**Appendix 3: Main wheel assembly service tag**

				0026989	
<b>SERVICEABLE</b>		25, SOBO AROBIOMI STR. GRA IKEJA, LAGOS. <input type="checkbox"/> OTHER <input type="checkbox"/>		<b>UNSERVICEABLE</b>	
PART NUMBER 3-1641		SERIAL NUMBER 1-227-20		MOD STATE SHELF LIFE	
QUANTITY 5954 OK TYPE REBUILD		DESCRIPTION MAIN WHEEL ASSY		POSITION #1	
APPROVED CERT. NO. [REDACTED]		SIGNATURE / AUTH [REDACTED]		TECH LOG REF. 00002791	
STATION 101		DATE 24/12/20		AUTHORIZATION NO.	

### Appendix 4: Daily Check for 13th January, 2021



JC No.: E145001APL-EMB	<b>MAINTENANCE JOB CARD</b>	A/C type: E145 LR/MR Engine : AE3007A1P
INTERVAL: 24 Cal. Hours	A/C Reg: <i>5N-BVD</i>	Rev. Date: 08.10.2020
TRADE: MEC/AVI		Revision : 6
MANPOWER: Mhr	WO Ref:	Effectivity: MSN:145203,145337,145322,145144, 145168,145199,145486,145379
TITLE: DAILY INSPECTION CHECK LIST		

NO.	JOB DESCRIPTION	STAMP					
		CERTIF.	INSP.				
1	<p>CHECK THE ENGINE OIL LEVEL ON THE SIGHT GAUGE (LH and RH SIDE) AND REPLENISH IF NECESSARY IAW AMM 12-12-01-600-801-A</p> <p><u>Note:</u> For oil level check prior to the first flight of the day, fill the engine oil tank until the oil reaches the one quart mark on the sight gauge. Prior to flights other than the first flight of the day, when the quantity is below the three quart mark on the sight gauge, fill the oil tank until the oil reaches the two quart mark on the sight gauge.</p> <p>Record any oil uplift in the table below and duplicate the record in Technical Log Book:</p> <table border="1" style="margin-left: 20px;"> <tr> <th>LH Engine</th> <th>RH Engine</th> </tr> <tr> <td style="text-align: center;"><i>/</i></td> <td style="text-align: center;"><i>/</i></td> </tr> </table>	LH Engine	RH Engine	<i>/</i>	<i>/</i>		
LH Engine	RH Engine						
<i>/</i>	<i>/</i>						
2	<p>CHECK THE HYDRAULIC SYSTEM 1 &amp; 2 RESERVOIR-FLUID LEVEL AND REPLENISH IF NECESSARY IAW AMM 12-13-01-600-801-A &amp; AMM 12-13-01-600-802-A</p> <p>Warning: Prior to inspection be sure that the Hydraulic System is depressurized.</p> <p><b>NOTE 1:</b> If System 1 &amp; 2 is lower than 5.5 liters (full mark). Refill until indicator shows full.</p> <p><b>NOTE 2:</b> If refill was more than 1 liter, record amount in the table below:</p> <table border="1" style="margin-left: 20px;"> <tr> <th>Refill</th> <td style="text-align: center;"><i>5 QRTS</i></td> </tr> </table>	Refill	<i>5 QRTS</i>				
Refill	<i>5 QRTS</i>						
3	<p>TEST THE PILOT'S AND COPILOT'S DIGITAL CLOCK IAW AMM 31-21-00-700-802-A</p>						
4	<p>DO A VISUAL CHECK OF THE APU OIL LEVEL THROUGH THE OIL LEVEL SIGHT GLASS. ADD LUBRICATING OIL AS REQUIRED IAW AMM 49-96-00-200-801-A</p>						



5N-BVD

**Appendix 5: Aircraft maintenance statement**



**AIRCRAFT CERTIFICATE OF RELEASE TO SERVICE AND MAINTENANCE STATEMENT**

AIRCRAFT TYPE: ..... **EMB-145**..... REG. MARK: ..... **5N-BVD**.....  
 WORK ORDER #/REF: ..... **WP200088-BVD**..... DATED:..... **23<sup>RD</sup> DEC, 2020**.....  
 SCHEDULED MAINTENANCE /INSPECTION CHECK: **1A+ROUTINE+WEEKLY+DAILY CHECK+ADDITIONAL CHECKS IAW ERJ 135/145/MP3 Issue 02 Rev 01 DATED 17<sup>TH</sup> SEPTEMBER,2019**. WAS COMPLETED ON  
 DATE : **22/01/2021** AIRFRAME HOURS: **4775.57** AND **36050**.....TOTAL LANDINGS(CYCLES)  
 LOCATION WHERE CHECK WAS COMPLETED **Execurt**..... **LAGOS Nigeria**.....

It is hereby certified that the work specified above except as otherwise noted, has been carried out in accordance with requirements of Nigerian CARs- Part 9 and the appropriate aircraft Maintenance Programme and in respect to that work, the Aircraft/Equipment is considered approved for "Release to Service".

REMARK (IF ANY) .....

SIGNED: [Redacted Signature]

(APPROVED CERTIFYING STAFF) EXECUTIF AMO/SMEAN: (PRINT NAME OF CERTIFYING STAFF)

LICENCE NO/STAMP: ..... DATE: **22/01/2021**.....

NAME OF THE Nigerian CAR - Part 9 ORGANIZATION: ..... **AIR PEACE** .....

NCAA APPROVAL REFERENCE NO: .....**REF NCAA/DAWS/AD1103/VOL.8/34**.....

AIPLANE OWNED BY: ..... **AIR PEACE LIMITED** .....

The next Schedule Maintenance Inspection ( **2A CHECK** ) is due after midnight of ... **26<sup>TH</sup> APRIL,2020**..... or upon completion by the aircraft of ...**42557 FH**.....whichever is sooner.

The following 'out of phase' Inspections/components changes are due before the next scheduled Maintenance Inspection specified above.

PART NO	S/NO	ITEMS DESCRIPTION	DUE	
			HOURS	DATE
		NIL		

PREPARED BY (NAME) [Redacted Name]

SIGNATURE: [Redacted Signature]

25, SOBO AROBIODU STREET, IKEJA G.R.A. LAGOS

APL-EM-027

5N-BVD

**Appendix 6: Certificate of registration of aircraft**

**NIGERIAN CIVIL AVIATION AUTHORITY**



Certificate Number <b>1581</b>
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**CERTIFICATE OF REGISTRATION OF AIRCRAFT**

1. Nationality and Registration Marks  <b>5N - BVD</b>	2. Manufacturer and Manufacturer's Designation of aircraft  <b>EMPRESA BRASILEIRA DE AERONAUTICA SA  EMB-145LR</b>	3. Aircraft Serial Number  <b>145199</b>  4. Date of Manufacture  <b>NOV., 2000</b>
5. Name of Registered Operator  <b>AIR PEACE LIMITED</b>		
6. Address of Operator  <b>25, SOBO AROBIODU STREET, G.R.A IKEJA, LAGOS, NIGERIA.</b>		
7. Name and Address of Owner  <b>SPRINGFIELD AVIATION CO. LLC 3525, PIEDMONT ROAD, 7, PIEDMONT CENTER ATLANTA, GEORGIA 30305. USA</b>		

8. It is hereby certified that the above described aircraft has been duly entered on the register of the Federal Republic of Nigeria in accordance with the Convention on International Civil Aviation Act 2006 and the Regulations issued thereunder.

9. Date of Issue **16TH OCTOBER, 2017**

by authority of the Nigerian Civil Aviation Authority

- NOTE:
1. No entries or endorsements may be made in the foregoing certificate except in the manner and by the persons authorised for that purpose.
  2. This certificate must be displayed aboard the aircraft.
  3. This certificate is not transferable.

P. T. O





5N-BVD

**Appendix 7: Aircraft certificate of release to service and maintenance statement**



**AIRCRAFT CERTIFICATE OF RELEASE TO SERVICE AND MAINTENANCE STATEMENT**

AIRCRAFT TYPE: ..... **EMB-145**..... REG. MARK: ..... **5N-BVD**.....  
 WORK ORDER #/REF: ..... **WP200088-BVD**..... DATED:..... **23<sup>RD</sup> DEC, 2020**.....  
 SCHEDULED MAINTENANCE /INSPECTION CHECK: **1A+ROUTINE+WEEKLY+DAILY CHECK+ADDITIONAL CHECKS IAW ERJ 135/145/MP3 Issue 02 Rev 01 DATED 17<sup>TH</sup> SEPTEMBER,2019.** WAS COMPLETED ON  
 DATE : **22.12.2021**... AIRFRAME HOURS: **41785.57** AND **36050**.....TOTAL LANDINGS(CYCLES)  
 LOCATION WHERE CHECK WAS COMPLETED **Execujet**..... **LAGOS Nigeria**.....

It is hereby certified that the work specified above except as otherwise noted, has been carried out in accordance with requirements of Nigerian CARs- Part 9 and the appropriate aircraft Maintenance Programme and in respect to that work, the Aircraft/Equipment is considered approved for "Release to Service".

REMARK ( [Redacted] )  
 SIGNED: [Redacted]

(APPROVED CERTIFYING STAFF) EXECUJET AMO/SMEAN/37 (PRINT NAME OF CERTIFYING STAFF)  
 LICENCE NO/STAMP: ..... DATE: **22/12/2021**

NAME OF THE Nigerian CAR - Part 9 ORGANIZATION: ..... **AIR PEACE** .....  
 NCAAA APPROVAL REFERENCE NO: .....**REF NCAAA/DAWS/AD1103/VOL.8/34**.....

AIPLANE OWNED BY: ..... **AIR PEACE LIMITED** .....

The next Schedule Maintenance Inspection ( **2A CHECK** ) is due after midnight of ... ..**26<sup>TH</sup> APRIL,2020**..... or upon completion by the aircraft of ...**42557 FH**.....whichever is sooner.

The following 'out of phase Inspections/components changes are due before the next scheduled Maintenance Inspection specified above.

PART NO	S/NO	ITEMS DESCRIPTION	DUE	
			HOURS	DATE
		NIL		

PREPARED BY (NAME) ..... [Redacted] ..... SIGNATURE: [Redacted]