

Loss of Normal Braking

Final Report

Airbus 330-343 Registration PK-LEM Flight XY5146

Lion Air Passenger Scheduled Service



Prince Mohammed Bin Abdul-Aziz International Airport (OEMA)
AL Madinah AL Munawrah, Kingdom of Saudi Arabia
23 Dhu'l -Q 1444H – 12 June 2023G

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Glossary	
Abbreviations and symbols used in this report	
°	Degrees
ATC	Air Traffic Control
AIB	Aviation Investigation Bureau
A/SKID	Anti-Skid
BEA	Bureau of Enquiry and Analysis for Civil Aviation Safety
BDDV	Brake Dual Distribution Valve
BSCU	Brake Steering and Control Unit
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
ECAM	Engine Crew Alerting and Monitoring
FCOM	Flight Crew Operating Manual
FC	Flight Crew
GS	Ground Speed
HYD	Hydraulic
ICAO	International Civil Aviation Organization
L/H	Left Hand
KNKT	Komite Nasional Keselamatan Transportasi
MLG	Main Landing Gear
NTSC	National Transport Safety Center
N/W	Nose Wheel Steering
R/H	Right Hand
FO	First Officer
ARFF	Aircraft Rescue Fire Fighting
PF	Pilot Flying
PIC	Pilot In Command
FO	First Officer
PCN	Pavement Classification Number
PSI	Pressure Per Square Inch
T/R	Thrust Reverser
SOP	Standard Operating Procedures
UTC	Universal Time Coordinated

Notification

On June 12, 2023, at 19:29¹ UTC, Operations Safety of Prince Mohammad Bin Abdul-Aziz International Airport (OEMA) notified the National Transport Safety Center (NTSC) of a landing incident for Loin Air Flight XY5146. The aircraft, an Airbus 330-343 registered as PK-LEM, came to a stop 600 meters short of runway 18 end with all wheels burst, along with resulting secondary damages. The passengers disembarked using mobile stairs, and there was no report of injuries.

The Saudi Arabian National Transport Safety Center notified the event to following parties:

- Komite Nasional Keselamatan Transportasi (KNKT) of Indonesia as the State of registry.
- Bureau d'Enquete et d'Analyse for Civil Aviation Safety (BEA) in France as the State of Design and Manufacturing.
- International Civil Aviation Organization (ICAO).

BEA and Airbus accredited representatives were assigned to participate in the investigation, and one nontraveler from Indonesia KNKT.

NTSC Investigation objective

NTSC Regulation and Annex 13 to the Convention on International Civil Aviation states it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the final report is the prevention of accidents and incidents.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the state having responsibility of which the recommendations are addressed.

¹ Unless otherwise specified, all times in this report are Coordinated Universal Time (UTC). Kingdom of Saudi Arabia (KSA) time is UTC plus three (+3) hours

Synopsis

On 12 June 2023, Lion Air operated flight XY-5146 (for Fly NAS) with an Airbus 330-343 of PK-LEM registry. This was the return sector of a flight pairing as a scheduled flight serving Prince Mohammad Bin Abdul-Aziz International Airport in Madinah (OEMA), to Prince Said International Airport (FMCH), Comoros Island. The flight operated under a wet lease agreement giving Lion Air full operational control as the lessor. On board were 390 passengers, and the flight was operated by 3 flight crew, 11 cabin crew, and 2 flight technicians.

At approximately 04:00, the Flight Crew arrived at the airplane and started the mandated Preliminary Cockpit Preparation as part of the normal procedure checklist. The five-hour flight from Madinah to Comoros, inclusive of all phases of the flight, was uneventful. The aircraft landed at Comoros (FMCH) at 10:36, with a ground time of 3 hours and 42 minutes.

The flight crew and line maintenance completed their walk-around, and the aircraft was released for flight. Engine start; taxi, and takeoff proceeded normally. Approximately 5 minutes after takeoff, while in climb, the loss of the Green Hydraulic system alert message appeared on the Electronic Centralized Aircraft Monitoring (ECAM). The Flight Crew performed the checklist and decided to continue to their destination.

With one hydraulic system failure, provided other aircraft systems were normal, it was safe to continue the flight. Madinah airport runway characteristics and length were considered suitable for a destination. The flight crew expected that the Blue Hydraulic system would provide (safe) alternate braking.

On arrival, the flight crew requested from Madinah Control towing assistance after the landing, no emergency was declared, nor was it necessary. The towing request was a result of inoperable Nose Steering because of the hydraulic Green System loss. After landing on runway 18, the Pilot flying (PF) selected full Thrust Reverse and began to apply the brakes with the brake pedals. However, the PF sensed no deceleration. The PF called for a “loss of braking” checklist and completed all (memory) items. In compliance with the checklist, the pilot monitoring (PM) switched OFF the Anti-skid, and the PF initiated another full braking application. However, the PF was surprised that the alternate braking system did not activate. The PF immediately applied the parking brake to stop the aircraft, and was successful in stopping the aircraft. The aircraft was stopped 600 meters before the runway threshold. The use of the parking brake caused rapid and excessive rise in the brake temperatures,

eventually all the main landing gear tires burst, and the aircraft rested on its tire rims.

The captain called ATC for mobile stairs and ordered normal passenger disembarkation. No injuries or fire were reported, and the aircraft sustained minor damage. Aircraft Rescue Fire Fighting service (ARFF) arrived at the scene precautionary monitored the disembarkation.

The investigation revealed that the alternate braking pressure system, with the use of braking pedals, failed to engage.

The NTSC determined the probable cause of the occurrence was the improper installation of the Right-Hand Master Cylinder within the low-pressure circuit of the alternate braking system, and the flight crew incomprehension of the alternate braking system preflight testing.

Four prevention recommendations were addressed to Lion Air maintenance, flight crew action, and Airbus.

1. Factual Information

1.1 History of Flight:

On 12 June 2023, Lion Air operated flight XY-5146 (for Fly NAS) with an Airbus 330-343 of PK-LEM registry as a scheduled flight serving between Prince Mohammad Bin Abdul-Aziz International Airport in Madinah (OEMA), Saudi Arabia, and Prince Said International Airport (FMCH), Comoros Island, with a return sector back to Prince Mohammad Bin Abdul-Aziz International Airport in Madinah. The Aircraft was operated under a wet lease agreement with Lion Air, exercising full operational control as the lessor. There were 390 passengers, 3 flight crew members (augmented), 12 cabin crew members, and 2 flight technicians on board.

At Madinah station, the maintenance crew performed a pre-departure daily check, which was entered in the aircraft logbook. The aircraft was released for the flight by 04:26. The aircraft dispatch was made with one Minimum Equipment List (MEL) open item (an inoperative fuel pump). The technical logbook was clear of system malfunctions.

The Flight Crew arrived at the aircraft at approximately 04:00 and performed the Preliminary Cockpit Preparation in accordance with the normal procedure checklist. This included checking the Alternate Braking for the day's first flight (Figure 19).

The flight to Comoros was uneventful. The aircraft ground time at Comoros (FMCH) was 3 hours and 42 minutes. While on the ground, maintenance personnel assigned to the flight from Madinah completed the walk-around check and released the aircraft by signing the aircraft technical logbook. The aircraft taxied out (14:27) towards runway 20. Taxing involved a backtrack for runway 20 which also was non-eventful. A 180° turn on the runway lined the aircraft with runway 20 centerline with the takeoff roll started at 14:34, (7 minutes taxi-time).

Five minutes after takeoff, climbing through 10,800 feet, the green hydraulic system pressure began to drop. The Electronic Centralized Aircraft Monitoring (ECAM) gave a green system low hydraulic pressure "G SYS LO PR" and a green reservoir low level "G RSVR LO LVL" amber warnings presentations (Figure 1). The "NORM BRK" and "AUTO BRK" ECAM fault amber messages shortly followed. The Pilot in Command (PIC) called to the cockpit the onboard maintenance crew to evaluate the situation. Based on the availability of the Blue hydraulic system and concerned with the length of the departure airport runway being comparatively shorter (2900 meters), Maintenance Control Center (MCC) agreed that it was best to continue to Madinah destination.

While in cruise, the flight crew took time to review all related checklists and actions associated with the landing with the LOSS of the GREEN system.

Approaching Madinah (OEMA – in clear, nighttime visual conditions), the flight crew advised Madinah Approach Control of the Green Hydraulic system failure, requesting assistance after the landing due to loss of “steering capability”. Subsequently, Madinah Approach Control declared an emergency.

Air Traffic Control suggested using runway 18, and it was accepted. During the approach and with respect to the loss of the green system, the flight crew extended the landing gear using Alternate Gear Extension procedures. The aircraft landing utilizing the Alternate Braking system also led to (1) Inoperative Auto brakes; (2) left, right, and nose gear doors in OPEN position; (3) Inoperative nose Wheel Steering; and Loss of Spoilers 1 and 5.

The aircraft landed at 19:40, with Full Thrust reverse immediately after touchdown, and on the first brake pedal application, the captain who was the pilot flying (PF) felt the braking to be ineffective and then reacted by acting on the QRH memory recall “Loss of Braking” checklist instructing the Pilot Monitoring (PM) to select the Anti-skid Nose and Wheel Steering (A/SKID & N/W STRG) switch to the OFF position. A second brake application, the PF perceived insufficient braking. Subsequently, the PF pulled and rotated the Parking Brake handle. The selection of the Parking Brake stopped the aircraft approximately 600 meters short of the runway end (figures 2 and 3) ... bursting all main landing gear tires (figures 4, 6, 7) and additional minor secondary damage. There was no fire. See Table 1, page 10, describing the sequence of events with a reference to Ground speed.

ATC notified the Aircraft Rescue Fire Fighting service (ARFF), which was prepared and quickly surrounded the aircraft as it came to a stop. Passengers disembarked safely using mobile stairs, and no injuries resulted.

Key DFDR Data of Parking Brake application. (See figure 5)

Ground Speed	Parking Brake to “ON”	Application Duration	Alternate Hydraulic Press
103 k	First Application	Less than 1 sec	Reached 1664 psi
86 k	2nd application	3 sec	Reached 2272 psi
03 k	3 rd	Kept ON	Reached 2000 psi



Figure 1 In-flight ECAM display of Green HYD system loss.



Figure 2 Madinah Runway 18



Figure 3 Cockpit view of the Aircraft stop position.



Figure 4 All Tires burst after the aircraft came to a stop.

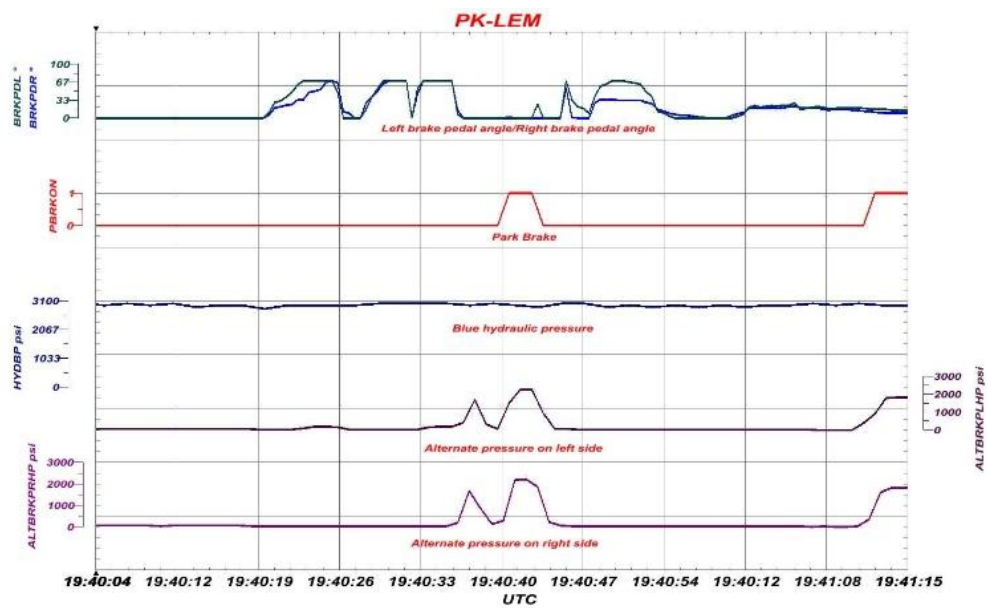


Figure 5 DFDR data: (1) as pedals were pressed, alternate pressure did not activate; (2) as the parking brake was SET, Alternate pressure activated.

Table 1 Key summary: “Braking Actions” versus Ground Speed.

GS (kt)	Action	Remark
152	Full Thrust Reverser 30 sec	At GS 41, T/R stowed
149	Pedals Applied for 7 sec	Alternate Brake pressure (32-160)psi
126	Anti-skid switch selected to “OFF”	
126	The Brake Pedals were applied for 8 seconds	Alternate Brake pressure (32-192) psi
104	First Parking Brake application	Alternate Brake pressure increased to 1664 psi (1.5 sec duration)
87	2 nd Parking brake application	Alternate Brake pressure increased to 2272 psi (3 sec duration)
Tire burst (CVR audio recording)		
60	Pumping Brake pedals	Alternate Brake pressure fluctuating between 32 to 64 psi
4	Parking brakes set	Alternate Brake pressure increase to 2000 psi

1.2 Injuries to Persons.

No injuries were reported.

1.3 Damage to Aircraft.

Minor damage after touching down as a result of the use of the Parking Brake:

1. All left and right main landing gear tires burst (figure 6).
2. All left and right main wheels were damaged (figure 7).
3. Both Main Landing Gear (MLG) doors have deep scratches (the result of ground contact; Figure 8).
4. BOGIE TRIMMER ACTUATOR” was leaking hydraulic, and a green actuator seal was protruding (figures 9 and 10)
5. Dented forward water drain mast (figure 11).
6. Hydraulic leaks at the left aft brakes, blue hydraulic lines (figure 12).
7. The left engine fan blade and acoustic panel (rubber debris) are damaged (figure 13).



Figure 6 Left gear tires.



Figure 7 Remanent of the Right gear tires.



Figure 8 Main Gear doors touching the ground, showing a hydraulic fluid stain.



Figure 9 The right trimmer actuator was leaking.

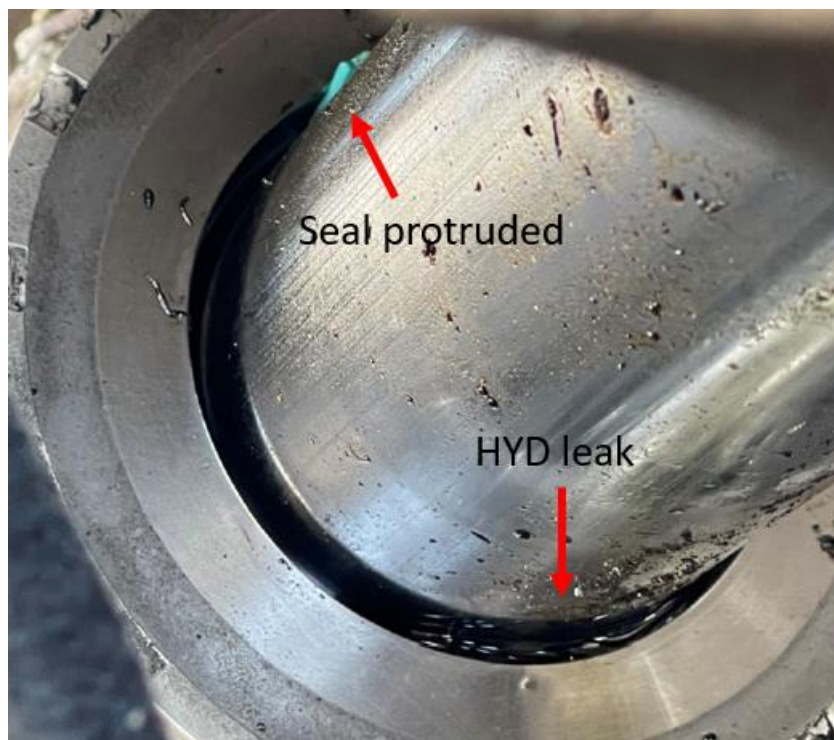


Figure 10 Extrusion of the right-trimmer piston seal.



Figure 11 Damaged FWD water drain mast.



Figure 12 Blue Hydraulic brake lines leak.



Figure 13 L/H engine aft Fan blades acoustic panel damaged (caused by tire rubber).

1.4. Other Damage

Runway 18 sweep inspection revealed surface scar damage (Figure 14).



Figure 14 Runway 18 light surface depth “white color scar” damage.

1.5. Personnel Information

Flight crew certification and flight record are reproduced below.

1.5.1 Pilot in Command

General information

PIC Information	
Age	53 years
License Type	ATPL
Date of issue	27-MAR-23
Date of expiry	30-SEP-2023

Medical certificate class	FIRST
Date of issue	12-APR-2023
Date of expiry	12-OCT-2023
Date of joining the operator	29-AUG-2004

Flight Experience

Total flying hours	16843:41
Total Commander Hours	10763:13
Total Multi-Engine Hours as PIC	13152:13
Total hours on type	2.464:10
Hours on type last 90 days	105:45
Hours on type last 28 days	59:35
Hours on type last 7 days	35:25
Rest period before flight	25:32 hrs
Current Instrument Rating	A-330 A320
Date of last Simulator Training	05/May/2023
Total Simulator Hours for the Past 12 Months	32:00

1.5.2 First Officer (Co-pilot)

General information

Age	40
License Type Class	CPL
Date of issue	06/Dec/2022
Date of expiry	31/Dec/2023
English Language Proficiency (ELP)/Expiry	14/Dec/2024
Medical Examination	FIRST CLASS
Date of issue	13/Apr/2023
Date of Expiry:	17/Nov/2023
Date of joining the operator	06/Apr/2023

Flight Experience

Total flying hours	3990:14
Total Commander Hours	-
Total Multi Engine Hours as PIC	-
Total hours on type	1057:26
Hours on type last 90 days	175:51
Hours on type last 28 days	86:35
Hours on type last 7 days	40:40
Rest period before flight	25:35 hrs
Current Instrument Rating	A330
Date of last Simulator Training	05/05/2023
Total Simulator Hours for the Past 12 Months	

1.5.3 Third Crew member (augmented captain)

General information

Age	48
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License Type	ATPL
Date of issue	06/05/2023
Date of expiry	31/12/2023
Medical Examination	FIRST CLASS
Date of issue	12/04/2023
Date of Expiry:	12/10/2023
Date of joining the operator	03/02/2023

Flight Experience

Total flying hours	20.365:00
Total Commander Hours	14.520:00
Total Multi Engine Hours as PIC	5170:15
Total hours on type	4.213:00
Hours on type last 90 days	72:00
Hours on type last 28 days	81:15
Hours on type last 7 days	40:40
Hours on type last 24 hours	0
Rest period before flight	30:35 hrs
Current Instrument Rating	A330
Date of last Simulator Training	08/05/2023
Total Simulator Hours for the Past 12 Months	16:00

1.6. Aircraft Information

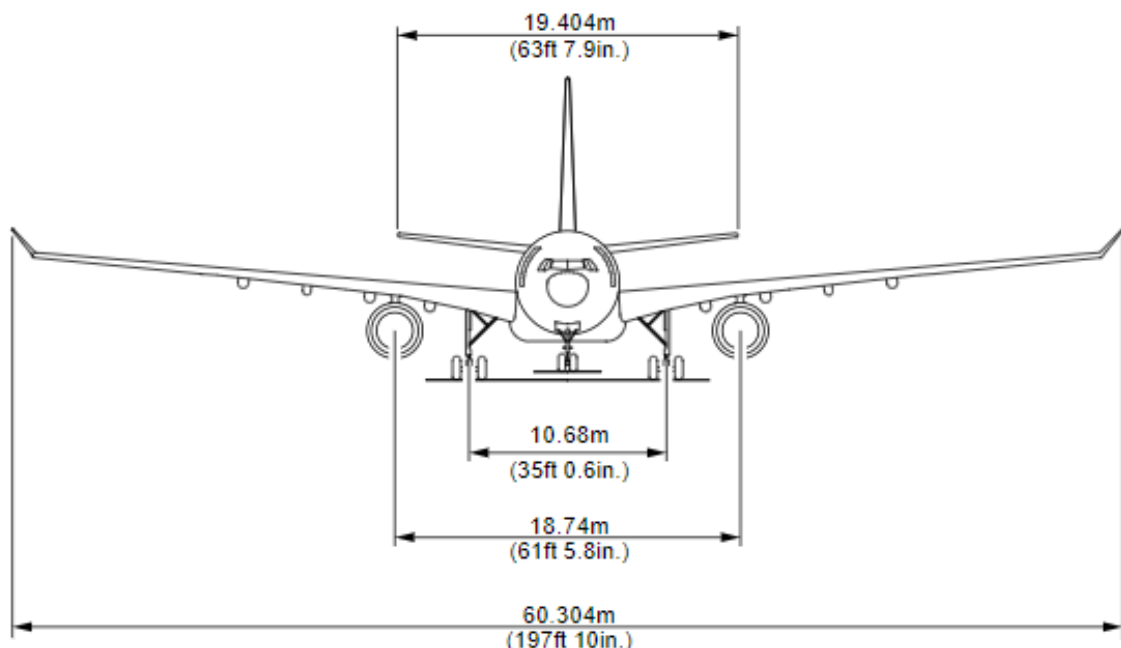


Figure 15 Aircraft Airbus-330 Dimensions

General Information & Technical History	
Aircraft Make/Model	Airbus/ 330-343
Aircraft Registration	PK-LEM
Engine Type	TRENT772B-60
Engine one S/N	42873

Engine two S/N	42874
Category	Commercial Air Transportation for Passenger, Cargo
MSN	1828
Date of Manufacture	04 December 2017
Aircraft Registration	PK-LEM
Aircraft Owner	AS AIR LEASE 129 (IRELAND)
Expiry of (C of A)	22 Feb 2024
Operator	Lion Mentari Airlines
Total airframe hours and cycles	FH 12986 FC 3461

Aircraft Weight

Aircraft weight	Actual	Max
Take-off weight	197.845 K	242.000 k
Landing weight	166.618 k	187.000 k
Zero fuel weight	153.345 k	170.000 k

History of Aircraft Technical Log Write-Ups – Related to Alternate Braking (Table 2)

PK-LEM Technical Logbook FAULT Entries (February to May 2023).

Item	Entry	Date	Defect.	Description	Resolution	Clear Date	Status
1	Flight Crew	8 Feb 2023	B3467484	BRAKE ALT BRAKE RIGHT INDICATOR LOW PRESSURE	REF AMM TASK 32-43-00-870-801-A BLEEDING THE BREAKING SYSTEM AT THE WHEEL BRAKES C/O RESULT PRESSURE UP TO 500 PSI ON PRESS	8 Feb 2023	CLOSED
2	Flight Crew	13 Mar 2023	B3685863	RH BRAKE JERK DURING APPLY	REF AMM 32-46-00-740-807, PERFORM BITE BSCU RESULT TEST OK VISUAL CHECK RESULT NO FOUND LEAK	13 Mar 2023	CLOSED
3	Flight Crew	3 May 2023	B3685844	RIGHT BRAKE SPONG ALT PRESSURE	ACCUMULATOR ALTERNATE BRAKE OPS TEST GOOD	3 May 2023	CLOSED
4	Flight Crew	11 May 2023	B3722866	DURING ALTERNATE BRAKE CHECK RIGHT BRAKE PRESSURE LESS THAN 2000PSI	RESULT BRAKE ACU NITROGEN PRESSURE LOW PERFORM ADD NITROGEN PRESS 1500 PSI OPS TEST RESULT 2200 PSI	12 May 2023	CLOSED
5	Maintenance	26 May 2023	B3722899	DURING DAILY FOUND MASTER ACTUATOR CYLINDER LEKED	ACTUATOR CYLINDER D/T BROKEN REF AMM 32-43-12-04 CONF 00 OPS TEST NO FOUND LEAK AND SATISFIED	26 May 023	CLOSED
EVENT ENTRY: LOSS OF BRAKING (12 Jun 2023)							

Brake System General Description

Airbus A330 Braking system permits controlled aircraft speed movement on the ground. The brakes are located on the main wheels. The Normal braking system uses the Green hydraulic power, and the Alternate (BACK UP) braking system uses the Blue hydraulic power (Figure 21). The system contains the following:

- Normal braking
- Alternate braking with anti-skid (A/SKID)
- Alternate braking without anti-skid (A/SKID)
- Parking braking
- Indication (Triple Indicator)

Normal braking

The system is used to decrease the aircraft's speed when it moves on the ground. It also puts the brakes on momentarily after take-off to stop the rotation of the main wheels during landing gear retraction. The system is electrohydraulic and includes a computer, the Brake, and the Steering Control Unit (BSCU). The Green Main Hydraulic Power System supplies the hydraulic pressure that operates the brake pistons. Green hydraulic system failure will

cause an auto transfer to the blue hydraulic system, which will provide ALTERNATE braking systems to take over. Two brake pedal assemblies with two pedals in each assembly. They transmit the manual braking inputs to the BSCU through the brake pedal transmitter unit. When a force is put on a pedal, it turns, and the related pedal also turns. The low-pressure hydraulic system gives a resistance (artificial feel) in proportion to the pedal travel. The “**NORM BR**” Message on the system display wheel page in amber will come on when the normal braking has failed, when the GREEN hydraulic system is abnormally in low pressure, when engine 1 or 2 is running, or when the aircraft is in flight.

If the A/SKID & Nose Wheel Steering switched to “ON” (A/SKID & N/W STEERING)

When the GREEN hydraulic pressure is available, the antiskid and nose wheel steering are available. IF GREEN hydraulic pressure is lost, the BLUE hydraulic pressure will automatically take over to supply the brakes, and the ANTISKID will remain available; however, the Nose wheel steering is lost.

If the A/SKID & N/W STEERING switched “OFF”

When the aircraft loses the GREEN hydraulic system, the BLUE hydraulic pressure supplies the brakes. However, the Antiskid is deactivated, and the Nose wheel steering is lost.

Parking Brake

The parking braking system is an electrohydraulic system. Its primary function is to prevent the aircraft's movement when parked. It can also be used to stop the aircraft if all the other braking modes are unavailable. The PARKING BRAKE is used as the last source of braking. The “ABNORMAL AND EMERGENCY PROCEDURES” memory items checklist has the procedures for how to use the parking brake in the case of “LOSS OF BRAKING.”

The Bogie Pitch Trimmer

The Bogie Pitch Trimmer maintains the required articulation link geometry to ensure the Bogie Beam front wheels are aligned upwards during the retraction sequence. This also enables the after wheels to contact the ground first during the landing sequence before facilitating the transition from two-wheel ground contact to four-wheel ground contact.

Triple Pressure Indicator

The *triple* pressure indicator (Figure 16) has three dials on its front face showing the brakes and accumulator pressures. When the Green system is not operating, and the blue system is active while pressing on the pedals, the Left and Right braking needles should move between 2400 and 2700 psi.

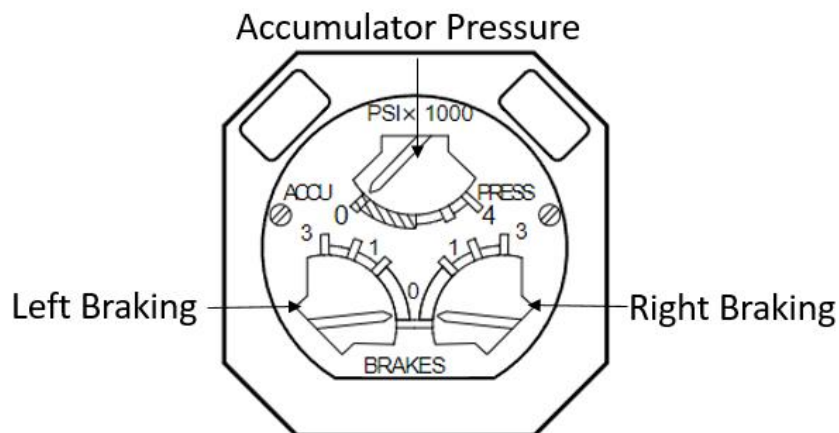


Figure 16 Triple Pressure Indicator

Spongy Braking

According to Airbus's experience, spongy pedals or low pressure reported by pilots could be caused by air trapped in the low-pressure command circuit (from pedals to Brake Dual Distribution Valve via master cylinders).

Loss of Normal Braking causes AUTO TRANSFER to Alternate

The Airbus Flight Crew Operating Manual provides a checklist for the loss of the GREEN HYDRAULIC SYSTEM (Figure 17). The auto-transfer hydraulic power of the braking system is from the Green (Normal) to the Blue (Alternate) hydraulic system. The normal pedal application will provide braking as needed.

Loss of Green QTY

- Causes auto transfer to BLUE SYSTEM

Auto Transfer to Backup

- The ALTERNATE PRESSURE will activate with brake pedals
- The ALTERNATE PRESSURE will activate with parking brake

LOSS of BRAKING

- Apply PARKING BRAKE HANDLE

Figure 17 Checklist for the loss of the GREEN HYDRAULIC SYSTEM

My Flight FCOM - 2023-05-16 - PK-LEM

Layer 1 Layer 2 Layer 3 WHAT IF NOTES 0 ECAM

FCOM - LNI (A330/A340) PRO ABN HYD HYD G RSVR LO LVL

HYD G RSVR LO LVL

GREEN ENG 1 PUMP OFF
GREEN ENG 2 PUMP OFF
GREEN ELEC PUMP OFF

G SYS LO PR

❗ If DC BUS 2 is lost or F/CTL FLAP SYS 1 FAULT is triggered:
MAX SPEED Refer to F/CTL FLAPS/SLATS FAULT/LOCKED
FUEL CONSUMPT INCRSD
FMS PRED UNRELIABLE

❗ WHEN AT TAXI SPEED:
ALTN N/W STRG ⬅ ON
Note: AUTO BRK system is not displayed as INOP SYS but remains inoperative.

SECONDARY FAILURES
*WHEEL
*F/CTL

STATUS

❗ If DC BUS 2 is lost or F/CTL FLAP SYS 1 FAULT is triggered:
MAX SPEED Refer to F/CTL FLAPS/SLATS FAULT/LOCKED

APPR PROC

❗ FOR L/G GRVY EXTN:
MAX SPEED 200 KT
LDG GRVY EXTN DOWN

❗ WHEN L/G DOWNLOCKED:
L/G (LEVER) DOWN
LDG DIST PROC APPLY

❗ WHEN AT TAXI SPEED:
ALTN N/W STRG ⬅ ON

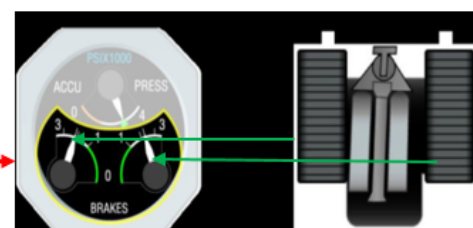
FUEL CONSUMPT INCRSD
FMS PRED UNRELIABLE
SLATS/FLAPS SLOW
CAT 3 SINGLE ONLY

INOP SYS
GREEN HYD
L/G RETRACT
PART SPLRS
CAT 3 DUAL
N/W STRG
AUTO BRK
NORM BRK

Figure 18 LOSS of the GREEN HYDRAULIC SYSTEM

Lionair A330/A340 FLIGHT CREW OPERATING MANUAL	PROCEDURES NORMAL PROCEDURES STANDARD OPERATING PROCEDURES - PRELIMINARY COCKPIT PREPARATION	
	Ident.: PRO-NOR-SOP-04-D-00010910.0001001 / 06 MAY 22	
PARKING BRAKE		
* ACCU PRESS indicator.....CHECK PM		
[E] The ACCU PRESS indication must be in the green band. If required use the electric pump on blue hydraulic system to recharge the brake accumulator.		
[L1] * PARK BRK handle.....ON PM		
[E] When one brake temperature is above 500 °C (or above 350 °C with the brake fans ON), avoid applying the parking brake, unless operationally necessary.		
[L1] * BRAKES PRESS indicator.....CHECK PM		
[E] Check for normal indications.		
[L1] WARNING The blue electric pump pressurizes the blue hydraulic system. Get ground crew clearance before to use the electric pump.		

Ident.: PRO-NOR-SOP-04-D-00010911.0001001 / 03 NOV 22		
ALTERNATE BRAKING SYSTEM		
The purpose of this check is to verify, before the first flight of the day, the efficiency of the alternate braking system (absence of "spongy pedals").		
CHOCKS.....CHECK IN PLACE PM		
PARK BRK handle.....OFF PM		
[E] The ACCU PRESS indication must be in the green band. If required use the electrical pump on the blue hydraulic system to recharge the brake accumulator.		
[L1] BRAKE PEDALSPRESS PM		
[E] Apply maximum pressure on both pedals.		
[L1] BRAKE PRESSURECHECK PM		
[E] Check on BRAKE PRESS indicator:		
- The pressure builds up without delay symmetrically on left and right sides for the same application simultaneously applied on left and right pedals.		
- With full pedal deflection, the pressure is between 2 200 PSI and 2 700 PSI.		
[L1] BRAKE PEDALSRELEASE PM		
PARK BRK handle.....ON PM		



Triple Indicator

L&R Pedals

Figure 18 Alternate Brake System first flight check

Lionair A330/A340 FLIGHT CREW OPERATING MANUAL	PROCEDURES ABNORMAL AND EMERGENCY PROCEDURES BRAKES	
	Ident.: PRO-ABN-BRAKES-00010903.0001001 / 05 JUN 18 Applicable to: ALL	
[MEM] LOSS OF BRAKING		
● If no braking:		
REV.....MAX		
[E] If needed, the flight crew may keep maximum reverse thrust until full aircraft stop.		
[L1] BRAKE PEDALS.....RELEASE		
[E] When the flight crew sets the A/SKID & N/W STRG sw to OFF, the alternate braking mode is activated. Consequently the PF should release the brake pedals before the PM selects the A/SKID off. This action avoids brutal braking application. For information on the alternate braking mode, Refer to DSC-32-30-10 Alternate Braking Without Antiskid.		
[L1] A/SKID OFF.....ORDER		
[E] The PF orders the PM to set the A/SKID & N/W STRG sw to OFF.		
[L1] A/SKID & N/W STRG.....OFF BRAKE PEDALS.....PRESS MAX BRK PR.....1000 PSI		
[E] Limit brake pressure to approximately 1 000 PSI. Monitor brake pressure on the BRAKES PRESS indicator.		
● If still no braking:		
[L1] PARK BRAKE.....USE		
[E] Use short successive parking brake applications to stop the aircraft. For more information on the parking brake, Refer to DSC-32-30-10 Parking Brake.		

Figure 19 COMPLETE LOSS of BRAKING checklist

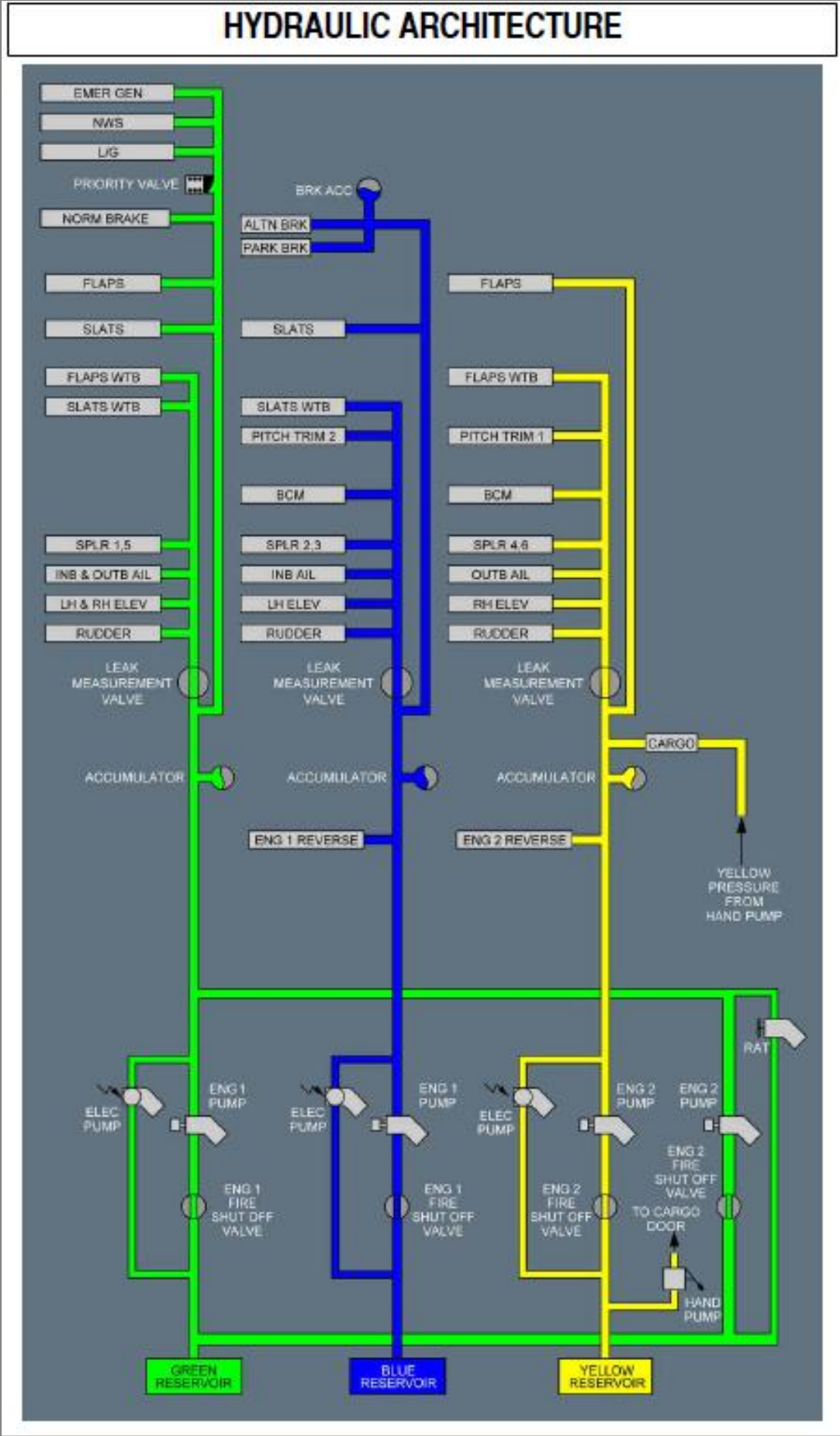


Figure 20 Main Hydraulic power supply users

1.6.1 Aircraft Manuals

Memory Items (MEM)

Memory items are procedures of an ECAM or QRH procedure that the flight crew must apply by memory to ensure a safe flight path. In some time-critical situations, the flight crew has no time to refer to the ECAM and/or to the Quick Reference Handbook (QRH). In this event, the Flight Crew used LOSS OF BRAKING MEM (Figure 20).

Trouble Shooting Manual (TSM)

The Troubleshooting Manual (TSM) is a manual provided by the manufacturer to provide comprehensive and systematic procedural coverage of aircraft warnings and malfunctions reported by the flight crew or maintenance to identify the root cause and repair the aircraft malfunctions accordingly. In this event, the Maintenance did not use the TSM to find the root cause.

Aircraft Maintenance Manual (AMM)

The Aircraft Maintenance Manual (AMM) is a manual developed by the manufacturer that provides detailed technical maintenance instructions for a specific type of Aircraft, such as component removal, installation, test, and adjustments.

1.7 Meteorological Information

At 19:00 ATC METAR, indicated the surface wind at Madinah airport (OMEA) was 230° at 8 knots with Visibility more than 10km. There was no cloud coverage. The temperature was 33°C, dew point 7°C, QNH 1010, with no significant changes forecast.

1.8 Navigation Aids

There were no known deficiencies of any air navigation facilities relevant to the occurrence.

1.9 Communications

Recorded Flight crew and ATC controllers' communications were retrieved. When approaching OEMA at night, the Flight Crew contacted Madinah Approach Control and informed them that the aircraft had a hydraulic green system failure and was expecting to block runway 17 due to no steering capability. Accordingly, Madinah's Approach Control declared an emergency. A few minutes later, the Air Traffic Controller called back and asked the FC if they would accept to land on runway 18. The FC accepted. The FC explained the type of problem and the status of the aircraft, and they did not declare an emergency. However, they confirmed the nose wheel steering would not be operating.

At 19:36:15, the FC received clearance to land on runway 18 with a wind direction of 240°/09 knots. After the aircraft landed, the FC contacted the ATC

at 19:42:09, informing them that the aircraft was on the runway. They requested an observer to check if there was fire or smoke coming from the aircraft due to tires bursting.

The ARFF approached the aircraft and reported to the ground TWR that all wheels and tires were damaged and smoke was coming from the left side of the landing gear. No fire was reported. The passengers evacuated with the normal air stairs from the left side. The ARFF later reported to the TWR that the situation was under control and only 2 ARFF vehicles would remain on standby for the aircraft.

1.10 Aerodromes Information

Madinah Airport

Prince Mohammad Bin Abdulaziz International (OEMA) coordinates are Lat. 24°33'01"N- Long. 039°42'21"E. It is located 13 kilometers north-east of Madinah Al-Munawarah city (Figure 22). The airport elevation is 2134 ft. It has two asphalt runways: 17/35 and 18/36. The level of rescue and firefighting protection was provided according to aerodrome category 10.

Prince Mohammad Bin Abdulaziz - Madinah Al-Munawarah	
Aerodrome code (ICAO/IATA):	OEMA /MED
Airport name:	Madinah Al-Munawarah / Prince Mohammad Bin Abdulaziz International
Airport address:	P.O.Box 124 Al-Madinah Al-Munawarah Saudi Arabia
Airport authority:	General Authority of Civil Aviation
Type of traffic permitted:	VFR/IFR
ATS units provided with information:	Madinah Al-Munawarah TWR & Approach
Capability for removal of disabled aircraft:	No major recovery equipment of specialized nature. Aircraft Operators/Owners shall utilize airline pooling system arrangements.
Runway 18 Landing Distance :	3050 Meters
Runway 18 width:	45 Meters
Runway 18 true bearing:	183.80°
Runway 18 Strength (PCN) - surface	PCN 59/F/A/W/T - Asphalt

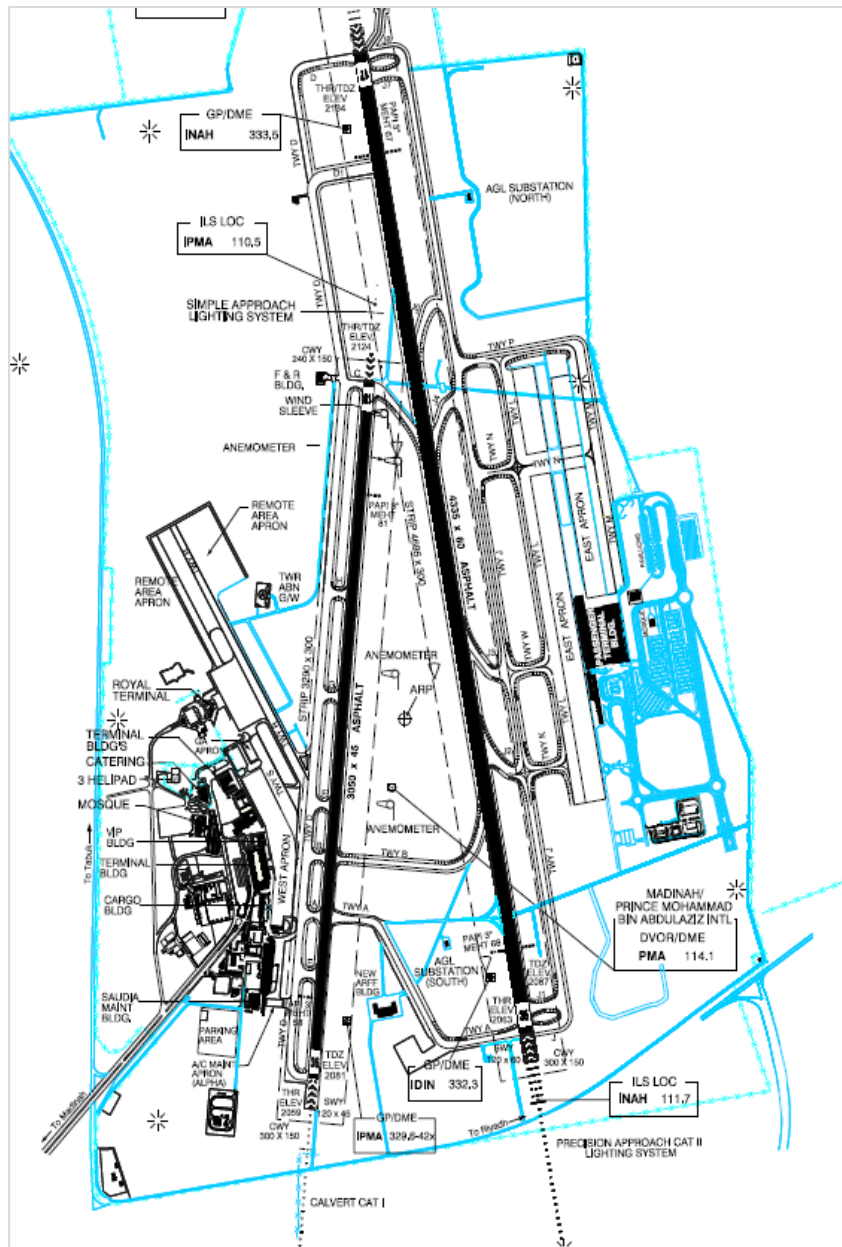


Figure 21 Prince Mohammad Bin Abdulaziz - Madinah Al-Munawarah Airport

Comoros Airport

Prince Said Ibrahim International (FMCH), coordinates are Lat. 11° 32' 11"S – Long. 043° 16' 17"E. It has one asphalt runway: 02/20. The airport elevation is 28.4 m (Figure 23)

Prince Said Ibrahim	
Aerodrome code (ICAO/IATA):	FMCH /HAH
Airport name:	Prince Said Ibrahim (AIMPSI)
Airport address:	P.O.Box 2527- MORONI-Union des Comores
Airport Administration:	ASCENA
Type of traffic permitted:	VFR/IFR
Runway 20 Landing Distance Available:	2900 Meters
Runway 20 width:	45 Meters
Runway 20 true bearing:	196°

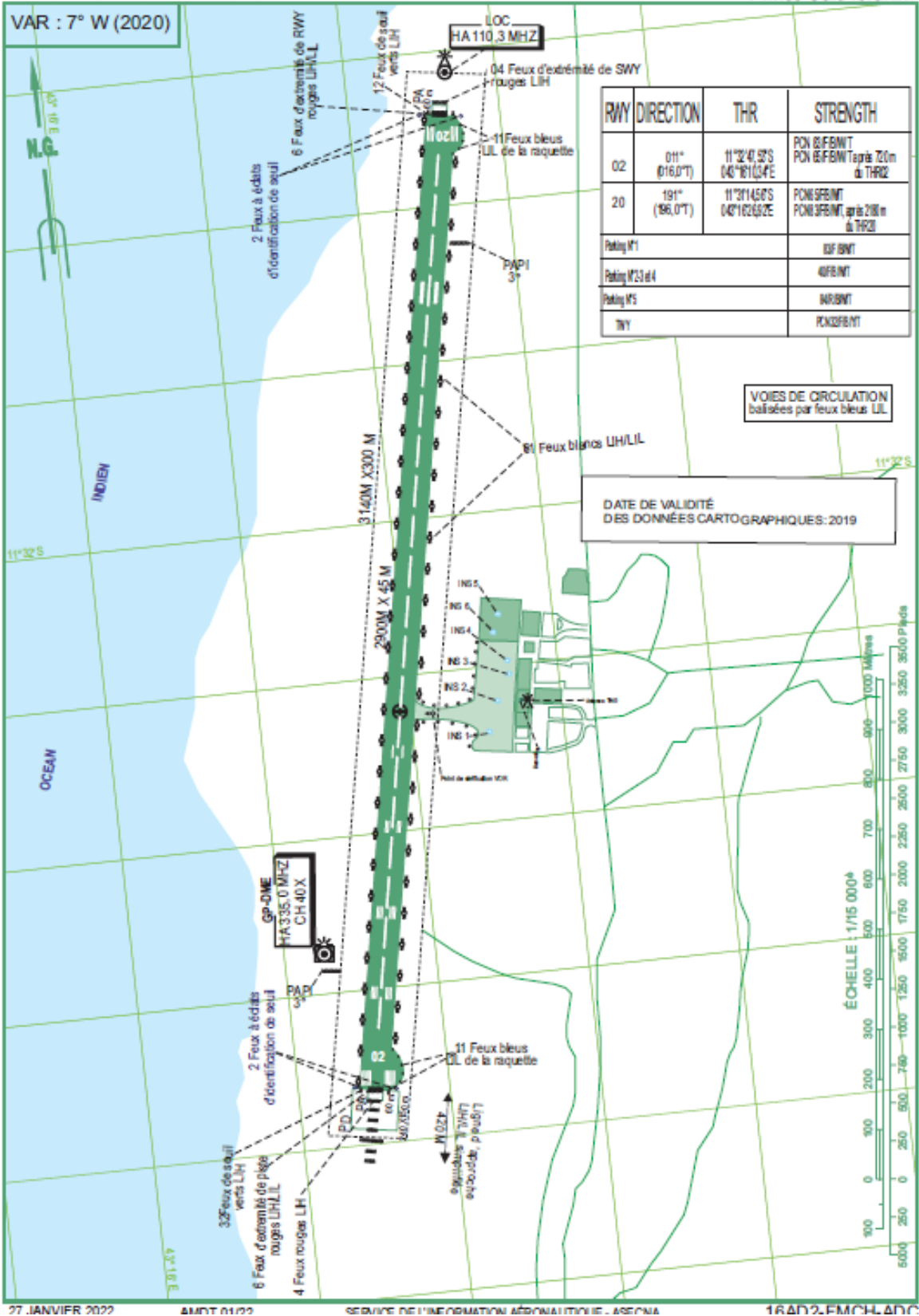
CARTE D'AÉRODROME - OACI
AERODROME CHART - ICAOARP: 11°32'11,47"S
043°16'16,77"EELEV: 28,4 m (93 FT)
GND: -24,8 m (-81,4 FT)TWR: 118,1 MHz
119,7 MHzMORONII
Prince Said Ibrahim

Figure 22 Prince Said Ibrahim Airport

1.11 Flight Recorders

The digital flight data was recorded (DFDR), and the Voice Recorder (CVR) were successfully retrieved and downloaded.

Type	Cockpit Voice Recorder (CVR)	Type	Flight Data Recorder (DFDR)
Manufacture	L3	Manufacture	L3
Part Number	2100-1226-02	Part Number	2100-2245-00
Serial Number	001178867	Serial Number	0012233242

1.12 Wreckage and Impact Information

Not Applicable.

1.13 Medical and Pathological Information

Post-accident medical examination (toxicological test) results show that the pilots are clear of psychoactive substances.

1.14 Fire

Alert two was declared, and the ARFF vehicles were standing by at the runway before the aircraft landed. No ARFF interventions were necessary, and no fire was reported.

Survival Aspects

The incident was survivable.

1.15 Tests and Research

Airbus proposal

To understand why the alternate brake system failed to operate, Airbus recommends removing the related components and sending them to SAFRAN facilities in France (Molsheim). The components were tested in reference to the Aircraft Components Maintenance Manual (CMM) and directives as given by invited expertise, Landing Gear System from SAFRAN and Airbus (See Table 3). One Saudi NTSC airworthiness investigator and a laboratory specialist witnessed the manufacture shop testing and Landing Gear System teardown. The inspection was conducted under BEA's supervision and Airbus representative from Airbus Product Safety.

Alternate Braking System components test at Safran facilitates results

The following components listed in Table 2 below were removed as Airbus proposed and sent to Safran and Airbus Landing Gear system experts for analysis. The test was performed as an individual test of each component. The results of the expertise are summarized below, and the full result is available in the Safran report reference CS/SE/2024/014, issue 1 dated 01 March 2024.

Test summary results (Table 2)

Components Name	Part Number	Serial Number	Findings
Trimmer Actuator	10-212701-001	CY1701837	Failed/crushed
Automatic Selector Valve	A25461	Y00841	passed
Park Brake Operated Valve	A25315	Y01306	passed
Shut-Off Valve	C24984	0624017	passed
Brake Dual Distribution Valve	A25434	Y00951	passed
Park Brake Selector Valve	C24703	Y00957	passed
Left-Hand Master Cylinder	C24592	Y01716	passed
Right Hand Master Cylinder	C24592	Y01482	passed
Hydraulic reservoir	C24891	Y00799	passed

1.16 Organizational and management information

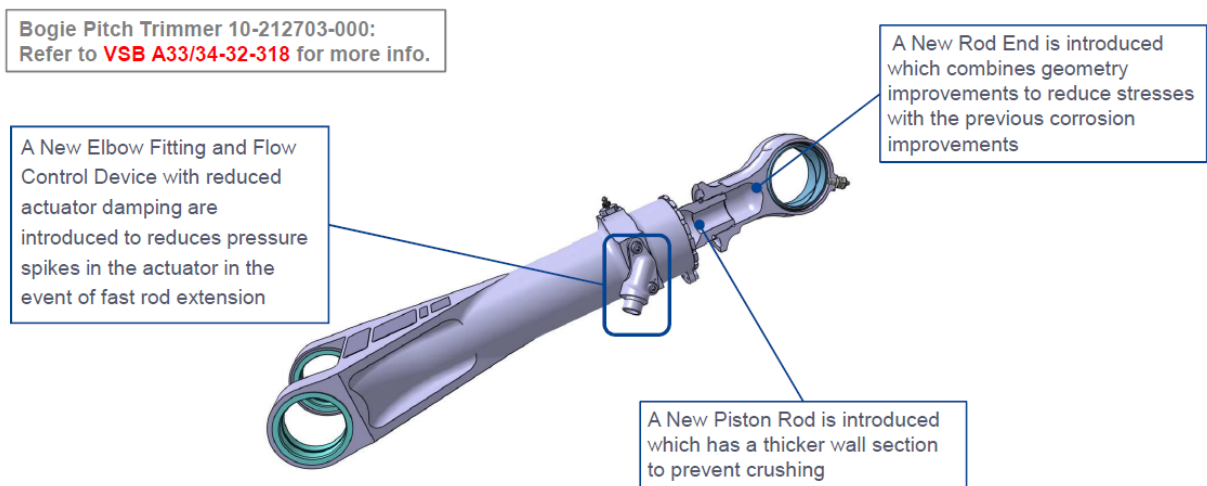
When the event occurred, the aircraft was under a wet lease agreement between Flynas Saudi Company as lessee and PT Lion Mentari Indonesian Company as lessor. The lessor maintains Operational Control of all flights while providing aircraft, flight crew, cabin crew, maintenance, and insurance.

Flaynas address	Lion Air address
Head office at Unit no.6 8018 Abi Bakr As Siddiq-Riyadh 13316-4040, Kingdom of Saudi Arabia.	Head office at Lion Air tower, Jl Gajah Mada No.7 Jakarta Pusat 10130, Indonesia

1.17 Additional information

Pitch Trimmer Operation, Modification, and Maintenance History.

Safran provided a full, detailed investigation report showing the root cause of the trimmer actuator failure, which will be explained in the analysis part of this report. Also, the Safran report shows the timeline of the lifecycles of the actuator (3460 FC / 12980 FH). The R/H MLG Movement Traceability Sheet (MTS) provided by the operator stated that the affected Bogie Pitch Trimmer had not been subject to any in-service removals during its operational life. The affected Bogie Pitch Trimmer P/N 10-212701-001 has been subjected to design improvement of corrosion resistance according to the recommended Service Bulletin (SB) A33/34-32-318 (Figure 24). In addition, SAFRAN expertise indicated that a modification to increase Bogie Pitch Trimmer robustness has been developed, as detailed in Service Bulletin (SB) A33/34-32-318 (Figure 24). This modification introduces a change to the flow control device, reducing the damping of the Bogie Pitch Trimmer to lower the build-up of internal pressure in the unit. This SB was not implemented on the PK-LEM Trimmer actuator, as indicated in the Actuator data plate (Figure 25).



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Figure 23 SB Enhanced Bogie Pitch Trimmer



Figure 24 R/H Trimmer Actuator data plate

2. Analysis

2.1 General

Aircraft systems, maintenance records, and crew performance are analyzed collectively to gain an understanding of why the aircraft alternate braking system checks, servicing, and test indications did not bring awareness of the actual degraded status. The analysis discussed:

1. Pitch Trimmer Actuator damage affected by uneven/wavy runway surface.
2. Component tests conducted on the Alternate Braking system.
3. Maintenance Technical Log.
4. The flight crew reactions.

2.2 Pitch Trimmer Actuator as the Cause of the GREEN SYSTEM LOSS

Approximately 5 minutes after takeoff, the Green Hydraulic system fluid was lost because of a damaged R/H Trimmer Actuator (BOIGE TRIMMER). The actuator was disassembled at the SAFRAN facility. The component teardown revealed a crushed piston rod (Figure 27) with a damaged scraper seal (Figure 10). This caused the Green hydraulic system loss, and consequently, the NORMAL BRAKE system failed. Despite losing the Green System, the BLUE alternate braking system pressure was available.

The Pitch Trimmer actuator is connected to the safety valve through the control manifold. The safety valve function is to stop the green hydraulic leak if the flow rate through the safety valve increases to more than a specified limit (a large amount of leak downstream of the safety valve). The leak rate was likely lower than the threshold specification of the safety valve. This is supported by the fact that it took 5 minutes for the low-quantity alert for the hydraulic green system to appear on the ECAM.

Root Cause of Damaged “Pitch Trim Actuator”

The damaged pistons have been on the manufacturer’s data, identifying the root cause as “irregular runway surface conditions” (figures 26, 28). Photos provided by other flights (on the next day) using the same runway exhibit rough runway surface areas visible to the right and left of the runway centerline. Queries to the airport operator to comment on the runway 02/20 surface condition remain unanswered. The manufacturer of the actuator, Safran, relied on In-Service Experience to identify the most common root cause for damaged Pitch Trim Actuators, as poorly maintained runway surface conditions during a one-off event, possibly on the last take-off out of Comoros. Note: Technical log records show the aircraft operated 4 flights to and from Comoros Aerodrome.

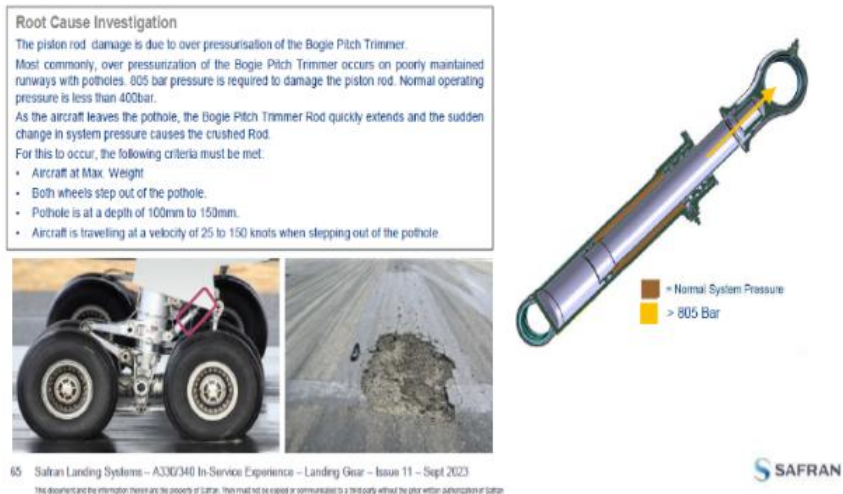


Figure 26 Extract out of Safran Inservice Experience report

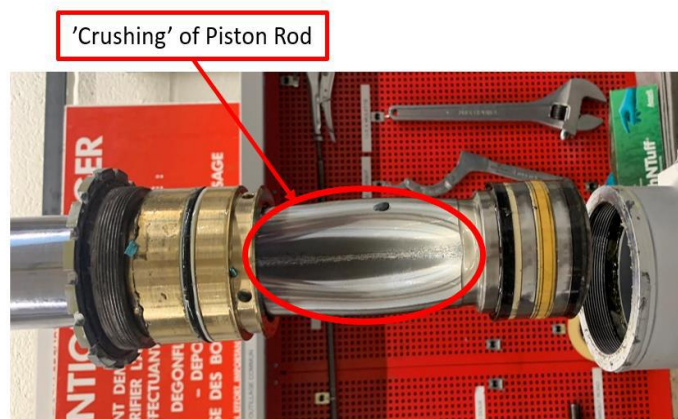


Figure 27 Pitch Trimmer Internal Piston damage



Figure 28 Photo showing the condition Comoros runway on the day following the event

2.3 Component Testing on the Alternate Braking System

BEA, Airbus, Safran, and the NTSC, collaborated in component testing of the Alternate Braking system. Test results showed all the components functioned normally.

2.4 Comments on Operator Airworthiness

Key airworthiness observations are listed that the investigation revealed, directly related to the continued operation of the aircraft while maintenance, troubleshooting practices:

- Misidentified the root cause(s).
- Incorrect interpretation of Airbus Technical Documents.
- No Recognition of Trend Occurrences.

Although the investigation did not isolate any intentional regulatory violations by the operator; however, it became evident from the Technical Log discrepancy entry, that the corrective action was ineffective.

The spongy pedal and low-pressure reading of the Triple Gauge reported by the Flight Crew are shown in Table 4, where the aircraft was returned to service without correcting the root cause. Incorrect maintenance corrective (invalid) actions did not approach nor resolve the root cause eventually identified in Table 4. When the number 5 entry fault was actioned, it was improperly performed.

A description of the fault scenario is summarized:

“All reported faults by the flight crew consistently identified issues with the right-hand pedals, that included faulty readings and a spongy pedal feel. Specifically, the fifth entry was the last entry following a series of complaints about the R/H pedals.

On 26 May 2023, mechanics found the R/H master cylinder was leaking hydraulic fluid. The leak in the master cylinder caused the spongy pedal sense in the Alternate Brake System low-pressure circuit. The Triple Indicator Gauge reading showed below acceptable pressure values for the right-hand alternate braking system”.

The No.5 fault entry, “A LEAK in the R/H master cylinder,” could have been identified receiving the first complaint if the maintenance crew used the Airbus TSM and executed it properly and would have cleared the write-up. However, the improper/error installation of the Right-hand Master Cylinder Actuator led to the Air being trapped in the Low-pressure Circuit and gave unacceptable indications in the Triple Gauge as shown in the DFDR data.

As a safety mitigation, Airbus conducted a workshop for Lion Air's maintenance department to enhance their practices for maintaining the braking system. Additionally, Airbus advised Lion Air's maintenance to inspect their A320 and A330 fleets to ensure the proper functioning of the alternate braking system.

Table 4. Aircraft Technical Log Defect Entries (Refer to Appendix 1 for more details of the maintenance actions)

#	Reported date	ENTRY (Exact wording)	MAINTENANCE CLEARING ACTION ENTRY	THE EXPECTED PROPER ACTION
1	8 Feb 2023	Crew entry BRAKE ALT BRAKE RIGHT INDICATOR LOW PRESSURE	REF AMM TASK 32-43-00-870-801-A BLEEDING THE BREAKING SYSTEM AT THE WHEEL BRAKES C/O RESULT PRESSURE UP TO 500 psi ON PRESS	To use TSM 32-43-00-810-807-A, TSM 32-43-00-810-802-A.
2	13 Mar 2023	Crew Entry RH BRAKE JERK DURING APPLY	REF AMM 32-46-00-740-807, PERFORM BITE BSCU RESULT TEST OK VISUAL CHECK RESULT NO FOUND LEAK	This fault requires more troubleshooting beyond BITE test on the BSCU and leak check.
3	3 May 2023	Crew Entry RIGHT BRAKE SPONG ALT PRESSURE	PERFORM SERVICING ACCUMULATOR ALTERNATE BRAKE OPS TEST GOOD	-Apply the procedures in the TSM 32-43- 00-810-802-A. -Enter Technical manual reference to indicate the corrective action used method.
4	11 May 2023	Crew Entry DURING ALTERNATE BRAKE CHECK RIGHT BRAKE PRESSURE LESS THAN 2000PSI	RESULT BRAKE ACU NITROGEN PRESSURE LOW PERFORM ADD NITROGEN PRESS 1500 PSI OPS TEST RESULT 2200 PSI	-Apply the procedures in the TSM 32-43- 00-810-807-A -Enter Technical manual reference to indicate the corrective action used method.
5	26 May 2023	Maintenance Entry DURING DAILY FOUND MASTER ACTUATOR CYLINDER LEKED	ACTUATOR CYLINDER D/T BROKEN REF AMM 32-43-12-04 CONF 00 OPS TEST NO FOUND LEAK AND SATISFIED	Maintenance used the correct task to remove & replace the R/H master cylinder however, it requires an operational test of the L/H and R/H of the ALT BRK. AMM 32-43-12-710-050-A. Most likely, the operational test was not performed, otherwise the failure will be obvious at the triple gauge indicator. The DFDR data from the flight event and the previous flights indicate the L/H & R/H of the alternate pressure were faulty.

2.5 Flight Crew

As A330 has no electronic continuous monitoring of the Alternate Braking system, the aircraft FCOM requires a *preliminary cockpit preparation* of the Alternate Braking system check before the first flight (Figure 19). The check verifies the availability of the Alternate Braking system by monitoring pressure indications on the Triple Pressure Indicator as the left and right pedals are pushed.

The flight crew stated that they performed the First Flight of the Day Alternate Brake checking action; however, the DFDR shows unacceptable brake pressure indications of less than 416 PSI on both alternate pressures as opposed to between 2400 psi and 2700 psi (Figure 29). Below pressure limits, when shown on the Triple Gauge Indicator, indicate NO ALTERNATE BRAKE AVAILABILITY.

Provided the GREEN SYSTEM is normal, the flight crew will not notice or become aware of the abnormal Alternate BRAKING System status if they misinterpret the triple indicator or overlook it. Below, Figure 28 describes the logical downgrade of the Alternate Brake System status based on Technical Log write-ups and DFDR data.

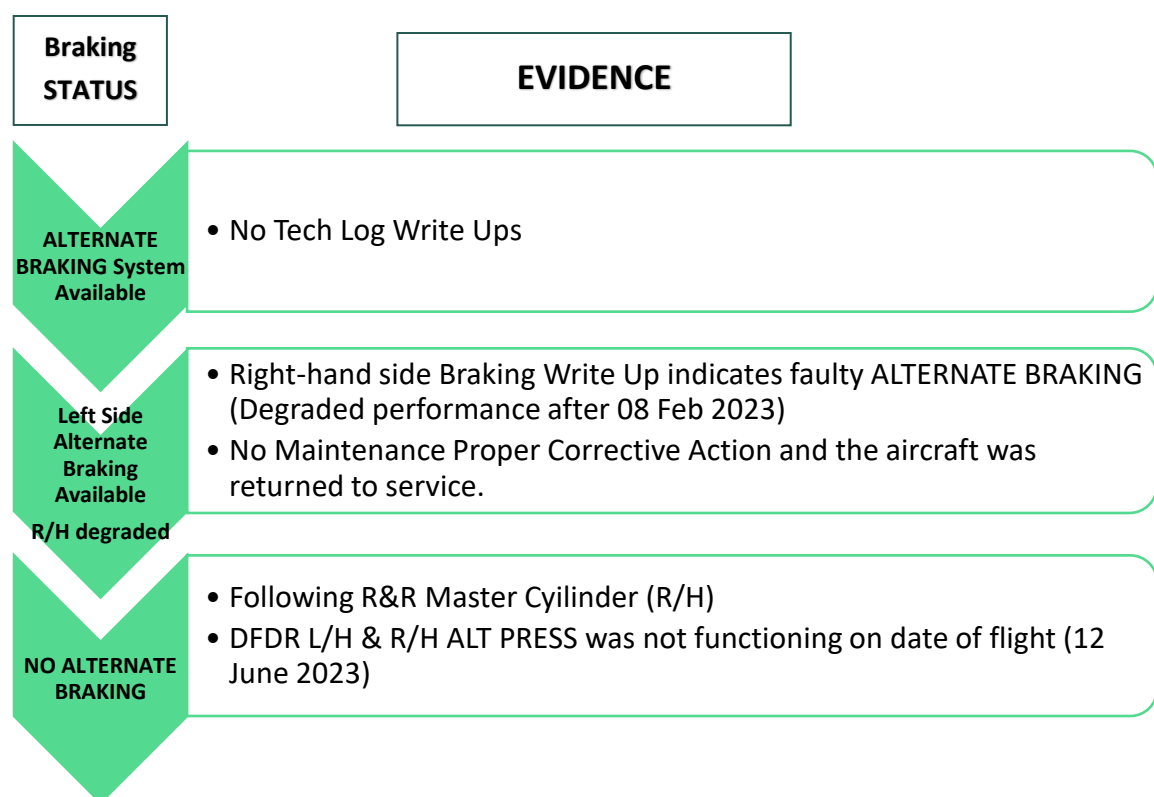


Figure 29 Logical downgrade of the alternate brake

On the date of the event, the flight crew's surprise at NO BRAKING after landing indicates that the flight crew was not aware of the Non-Availability of the Alternate Braking SYSTEM on touchdown.

The PF recovery action using the PARKING Brake was proper and effective, safely bringing the aircraft to a complete stop on the remaining runway surface; however, without “Anti-Skid” protection, it blew all the landing gear tires.

Extracted DFDR data provided details of the PF immediate recovery action marked against Ground Speed as he applied LOSS of Braking memory checklist actions. The L/H and R/H Alternate Pressure were activated using the parking brake and functioned normally. See table 5

Table 5. Parking Brake applications -by the Pilot Flying.

Ground Speed	Parking Brake to "ON"	Application Duration	Alternate Hydraulic Press
103 k	First Application	Less than 1 sec	Reached 1664 psi
86 k	2nd application	3 sec	Reached 2272 psi
03 k	3 rd	Kept ON	Reached 2000 psi

As part of safety mitigation, Airbus organized a workshop for Lion Air's flight operations to provide operational guidance on improving the interpretation of the pre-flight check for the alternate braking system and the loss of braking procedure.

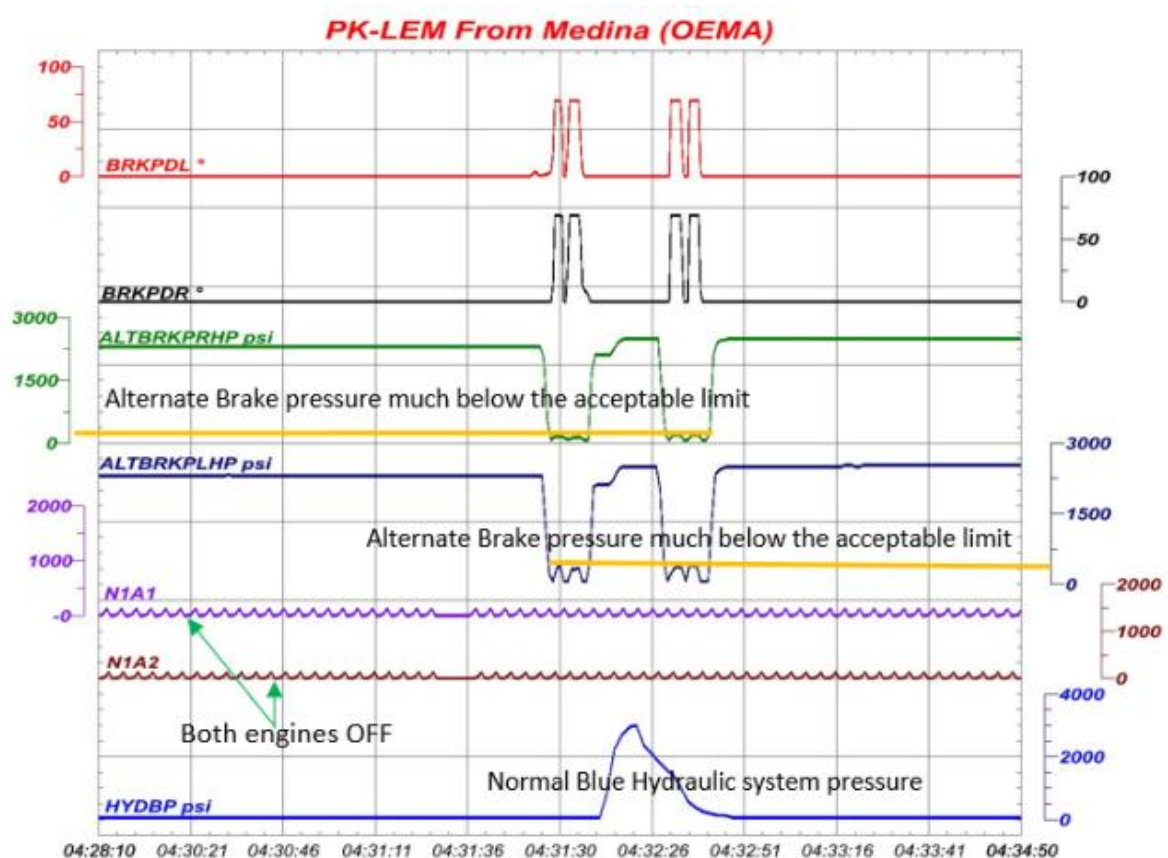


Figure 25 DFDR FC first flight check (12 Jun 2024) of the Alternate Brake shows the test was unsuccessful.

3. Conclusions

3.1 Findings

3.1.1 Flight Crew

1. The flight crew was properly trained and certified in accordance with existing regulations to conduct the flight.
2. The first Pre-flight Alternate check of the triple gauge indications was incorrectly interpreted.
3. LOSS OF BRAKE memory items checklist was properly implemented, successfully stopping the aircraft within the runway surface.
4. Flight crew coordination and Crew Resource Management (CRM) were optimal.
5. The decision to continue with the flight (shortly after takeoff) was shared with the Maintenance Control Center (MCC) and was in agreement with the prescribed procedures.

3.1.2 Airworthiness

1. The aircraft was properly certified under the Director of the Indonesian General Civil Aviation.
2. The First Flight Alternate Braking Preflight check indicated a FAILED ALTERNATE BRAKING system (with pedals), making the aircraft unairworthy for flight. This system degradation/failure extended from February 2023 up to the date of the occurrence.
3. Inappropriate usage of Airbus technical manuals to correct the faults.
4. Inspection of the Alternate Braking System suspect components proved to be functional.
5. Right-Hand Master Cylinder improper installation resulted in losing the use of the brake pedal for the L/H and R/H Alternate Braking.
6. Although the Blue Hydraulic System (quantity and pumps) were fully functional, the ALTERNATE BRAKE SYSTEM with pedals was not functioning (400 PSI output as opposed to 2200-2675 PSI of hydraulic pressure).
7. The failed Alternate Brake system with the left and right pedals was incapable to stop the aircraft on the runway within the landing distance.
8. The hydraulic Green System Pitch Trimmer Actuator damage is (suspected) due to runway surface irregularities as reported during the takeoff roll.
9. The damaged Pitch Trimmer Actuator caused the complete loss of the Green System hydraulic fluid.
10. The loss of the Normal Braking System was directly caused by the loss of the Green Hydraulic System.

11. The Alternate braking system was fully operational when using the parking Brake.
12. The proper use of the PARKING BRAKE, accessing the Alternate Blue Hydraulic System, brought the aircraft to a full stop on the runway.

3.1.3 Prince Said International Airport (FMCH), Comoros Islands

1. Verification of the runway surface condition was not responded to.
2. Post-occurrence photos gave support to flight crew statements of depressions spread as sporadic patches on the runway surface, left and right of the centerline.
3. The flight crew reported sensing runway “bumpiness and roughness” throughout the takeoff roll.

3.1.4 Prince Mohammad Bin Abdul-Aziz International Airport (OEMA)

ATC and Aerodrome Operations

1. No emergency was declared to ATC, only “TOW” assistance was requested (with respect to LOSS of NOSE WHEEL STEERING).
2. The ATC controller properly decided to declare ALERT II, deploying ARFF.
3. ATC's preference to change the landing runway from 17 to runway 18 was operationally justified.
4. The ARFF aircraft's external safety assessment report to the pilot and ATC was accurate.
5. Passenger stairs and support equipment were sent in a timely manner to the aircraft.
6. Runway 18 closure while runway sweeps were in effect was a safe decision.

3.2 Probable Cause

The NTSC determined the probable cause for the surprise loss of the Alternate Braking on the landing was the improper installation of the Right-Hand Master Cylinder within the low-pressure circuit of the alternate braking system, and the flight crew's incomprehension of the failed alternate braking system, as indicated by the Triple Gauge Indicator.

Equally significant is the 4-month failure in detecting the Alternate Brake System in the degraded condition, followed by the improper installation of the Right-Hand Master Cylinder.

Successful stopping of the aircraft on the usable runway was a result of the pilot flying quick response to memory checklist actions.

The contributing causes were: (1) Incorrect Maintenance compliance with Airbus technical documents; (2) the likelihood of a patchy wavy-surface runway damage effect on the Right-Hand Trimmer Actuator.

4. Recommendation

NTSC recommendations are addressed to Lion Air and Airbus.

Lion Air Airlines Maintenance and Operations

1. AIB-120623-966-SR-01

(Maintenance and Flight Operations) to raise the level of correct interpretation of Airbus technical manuals and operational guidance

[Airbus provided assistance to Lion Air]

2. AIB-120623-966-SR-02

Company Quality Control to improve closer monitoring of technical logbook entries for corrective actions.

3. AIB-120623-966-SR-03

Emphasize flight crew awareness of the A330 Alternate Brake System First Flight check for correct interpretation.

Airbus

4. AIB-120623-966-SR-04

Airbus to circulate to all A330 operators details of the occurrence, with emphasis focused on the risk of an undetected failed Alternate Brake System First Flight check. Operators to individually evaluate introducing an SOP, enhancing operational safety by having CM1 and CM2 dual verification of the Triple Gauge Indicator while performing the check.

Appendix 1:

The Following related defects, as received from the operator (Exact wording), are analyzed in detail as follows:

1. Compliant No. 1 “BRAKE ALT BRAKE RIGHT INDICATOR LOW PRESSURE”

The Flight Crew (FC) reported a low-pressure reading on the right brake pedal. According to Airbus experience, spongy pedals or low pressure reported by pilots could be caused by air trapped in the low-pressure command circuit (from pedals to BDDV via master cylinders). This indicates that the Triple Gauge Indicator Right needle was reading below 2200 psi when the pedal pressure. This fault likely appeared during the Flight Crew (FC) Alternate Braking System check as mandated by the Flight Crew Operations Manual (FCOM) as standard Operating Procedures (SOP). When such a fault exists, the possibility of one or more components or system failures in the Alternate Braking system Low-Pressure Circuit exists. This defect is outlined, and the solution is provided in Airbus Trouble Shooting Manual (TSM) 32-43-810-807-A (Alternate Braking Pressure Do Not Get to 2200 psi when Pedals are applied with the Blue Hydraulic system Depressurized) and TSM 32-43-00-810-802-A (Loss of Brake Pedal Artificial Feel or Spongy Feel). The TSM covers the possible cause of the defects. This includes the Alternate Brake reservoir, Master Cylinders, BDDV, hydraulic line connections, and pedal linkages. However, the Maintenance Crew did not use the TSM. Instead, they used the Aircraft Maintenance Manual (AMM) 32-43-00-870-801-A, which solely pertains to bleeding the Brake system at the wheel brake assembly.

Although using the AMM was not the proper action to fix the reported defect or to discover the cause, the AMM references shall direct the technician to conduct an operational test of the Alternate Brake system (AMM 32-43-00-710-801). This test aims to verify that the alternate braking system's Left and Right hydraulic systems read between 2400 and 2682 psi at the Triple Indicator when pedals are pressed. The technician most likely did not perform the operational test as commanded by the AMM procedures; otherwise, the test would fail.

The maintenance action and subsequent entry in the maintenance logbook indicated that the Triple Indicator still registered at 500 psi when its spouse read between 2400 and 2686 psi. This indicated that the defect was never resolved, the aircraft was returned to service, and the defects remained within the low-pressure circuit.

2. Compliant No. 2 “RH BRAKE JERK DURING APPLY”

The Flight Crew (FC) reported a jerking noise when applying the R/H brake. This jerking sensation is an audible noise and a palpable feeling during brake application. The jerking noise is often attributed to trapped air within the hydraulic lines, which requires bleeding. The maintenance crew's correction action was a brake and steering control unit bite test and a visual leak check. Identifying the precise cause of the jerking requires additional troubleshooting beyond just conducting a computer test (BSCU) and a leak check. In addition, the corrective entry did not indicate if the jerking noise was resolved or still exists after the maintenance action was completed or if the complaints required to be monitored by the FC on the next flight.

3. Compliant No. 3 “RIGHT BRAKE SPONGY ALT PRESSURE”

The pilot reported the right brake pedal feeling spongy, indicating a lack of artificial feel when applying the brake. This shows that the Triple Indicator might be reading below 2200 psi. According to Airbus experience, spongy pedals or low pressure reported by pilots could be caused by air trapped in the low-pressure command circuit (from pedals to BDDV via master cylinders)

This fault likely appeared during the Flight Crew (FC) Alternate Braking System check as mandated by the Flight Crew Operations Manual (FCOM) Figure xx. When such a fault exists, one or more components or system failure is possible in the Alternate Braking System Low-Pressure Circuit.

The proper action to deal with the defect is to use the Airbus Trouble Shooting Manual (TSM) 32-43-810-802-A (Brakes - Loss of the Brake-Pedal Artificial Feel or Spongy Pedals) to cover the possible cause of the defects and find the root cause of the defect. This includes a possible fault in the Alternate Brake reservoir, Master Cylinders, BDDV, hydraulic line connections, and pedal linkages.

However, the maintenance crew most likely used the AMM to service the Parking Brake accumulator “Functional check of Nitrogen Charge Pressure on Alternate Parking Brake Accumulator AMM 32-40-00-210-805.” Servicing the accumulator will not fix spongy brakes because the accumulator hydraulic circuits are separated from the low-pressure circuit. Therefore, the fault remained within the Alternate low-pressure circuit. In addition, there is no entry in the aircraft logbook of an aircraft-approved or acceptable manual reference, as required by the LNI procedures and SOP regulations, to address the task that was performed.

“It is the regulation by FAA/EASA that each person performing maintenance, or preventive maintenance on an aircraft shall use the methods, techniques, and practices prescribed in the current manufacturer's maintenance manuals or Instructions for Continued Airworthiness prepared by its manufacturer.”

4. Compliant No. 4 “DURING ALTERNATE BRAKE CHECK RIGHT BRAKE PRESSURE LESS THAN 2000PSI”

The pilot has reported a Triple Indicator with a low-pressure reading on the right brake pedal. This indicates that the Triple Indicator reads below 2200 psi. According to Airbus a spongy feeling or low-pressure reported by pilots could be caused by air trapped in the low-pressure command circuit (from pedals to BDDV via master cylinders). This fault was repeated for the third time within three months. The fault might have appeared during the FC Alternate Braking System check as required by the FCOM as SOP. When such a fault exists, the possibility of one or more components or system failures in the Alternate Braking System Low-Pressure Circuit is possible. The expected procedure is to use Airbus TSM to identify which components have failed.

This task involves troubleshooting the alternate brake reservoir, master cylinders, BDDV, and hydraulic connections in between. To solve the defects, the following documents need to be utilized:

- Airbus TSM 32-43-810-807-A (Alternate Braking Pressure Do Not Get to 2200 psi when Pedals are applied with the Blue Hydraulic system Depressurized and TSM 32-43-810-802-A).
- Airbus AMM Operational Test of the Alternate Braking system and;

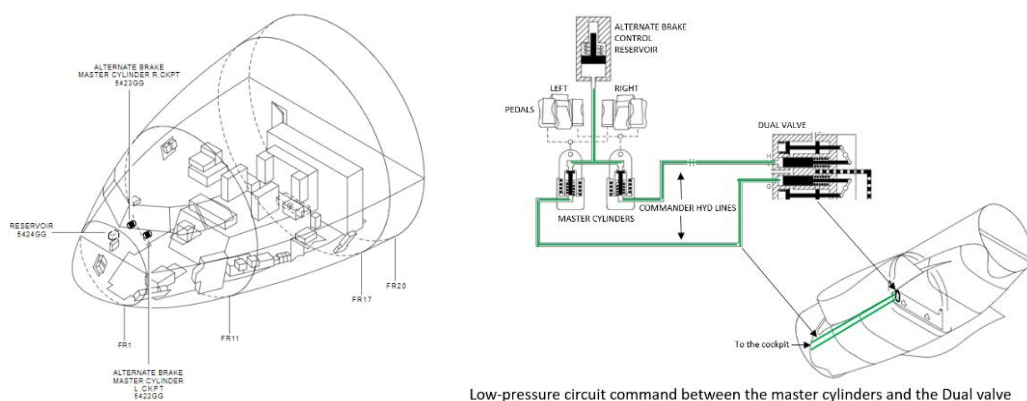
The maintenance crew mentioned in their corrective action they serviced the Brake accumulator and increased the pressure to 2200 psi; however, this corrective action serviced the Alternate Parking Brake accumulator, but it did not solve the possible defect/s within the Alternate Braking pressure Low-pressure circuit. Additional tests were required to identify the fault's root cause. Consequently, the fault within the Alternate Brake low-pressure circuit was not solved. In addition, no aircraft manual reference or approved/acceptable documents were entered in the corrective action.

5. Compliant No.5 “DURING DAILY CHECK FOUND MASTR ACTUATOR CYLINDER LEKED”

The function of the Master Cylinders is to change the mechanical inputs from its related pedals to a hydraulic pressure that operates the related valves to activate the hydraulic pressure. The maintenance

crew's finding was the last fault related to the Alternate Braking system reported before the event. The maintenance crew removed and replaced the defective master cylinder (R/H) with a new one, according to AMM 32-43-12-04, as indicated in the defect report.

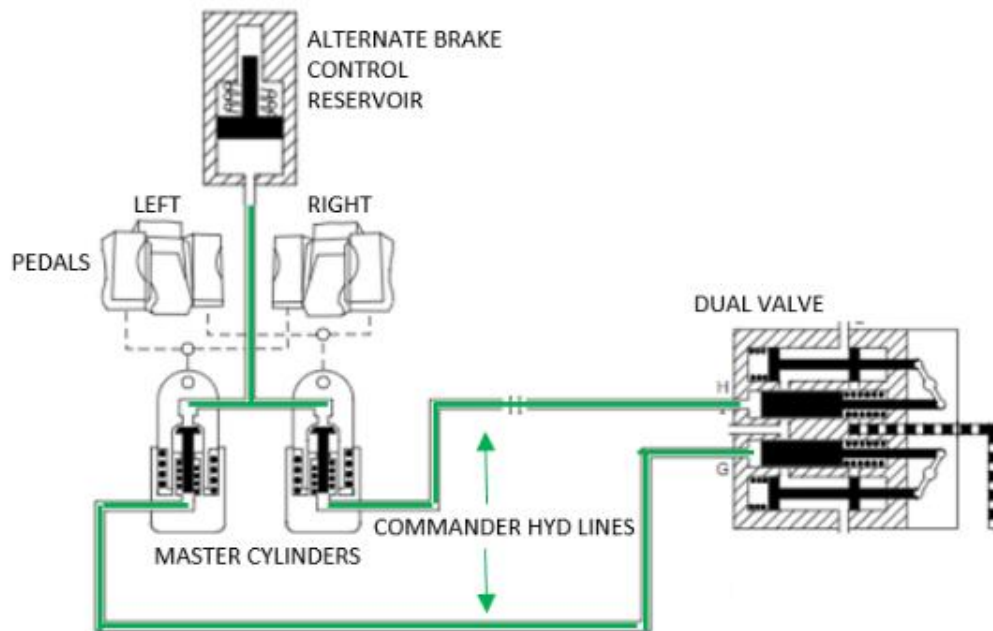
On 12, 06, 2023, the date of the event, while doing the first flight check of the alternate Braking system as required by the FCOM, the DFDR indicated that when the FDC pressed on the R/H pedal, the reading was 196 psi, significantly below the expected range of 2400 psi to 2686 psi. When pressing the left-hand (L/H) pedals, the pressure read 400 psi, falling outside the expected range. Since there was no complaint about the L/H pedal, this suggests a potential error in the removal and installation process of the R/H master cylinder might disturbed the low-pressure command lines. Additionally, the procedures for removing and installing the R/H master cylinder require testing the alternate braking pressure on both the left and right sides to ensure that the Triple Indicator shows a reading between 2400 psi and 2682 psi. However, DFDR data indicate that this test was either not conducted or was performed incorrectly. The loss of alternate braking is the failure to properly bleed the low-pressure command lines during the maintenance work on the R/H master cylinder replacement.



Low-pressure circuit between the Master cylinder and the Dual valve Summary of the combined faults.

All previous faults reported by the Flight Crew consistently identified issues with the right-hand (R/H) pedals, including faulty readings and a spongy feeling. Fault No. 5 was the last fault reported issue after a series of complaints about the R/H pedals. On 26 May 2023, the maintenance crew discovered that the R/H master cylinder was leaking hydraulic fluid. A leak in the master cylinder causes a spongy feeling and affects the low-pressure circuit in the alternate braking system, leading to the triple indicator reading

below the acceptable range. This explains the complaints related to the previous four faults reported by the FC. However, it appears that the maintenance intervention during the removal and replacement process affected the low-pressure commanded circuit, resulting in the loss of the alternate braking system. The hydraulic leak from the master cylinder is likely the root cause of the four reported defects, while improper maintenance actions or potential error processes during the removal and replacement of the R/H master cylinder are likely the cause of the loss of the alternate braking system (left and right), leading to the event.



Low-pressure circuit between the Master cylinder and the Dual valve

