



**FINAL INVESTIGATION REPORT ON
SERIOUS INCIDENT INVOLVING
M/s AIR ARABIA A320 AIRCRAFT A6-AOT
WHILE OPERATING SECTOR CHITTAGONG- ABU DHABI ON 6 JUNE 2022**

**GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU**

FOREWORD

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an Accident/Incident shall be the prevention of accidents and incidents and not to apportion blame or liability. The investigation conducted in accordance with the provisions of the above said rules shall be separate from any judicial or administrative proceedings to apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.

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GLOSSARY

AAIB	Aircraft Accident Investigation Bureau
AGL	Above Ground Level
AMSL	Above Mean Sea Level
ARC	Airworthiness Review Certificate
ARP	Aerodrome Reference Point
ASDA	Accelerate Stop Distance Available
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
ATPL	Airline Transport Pilot License
CoA	Certificate of Airworthiness
CVR	Cockpit Voice Recorder
CPL	Commercial Pilot License
DGCA	Directorate General of Civil Aviation
DFDR	Digital Flight Data Recorder
FCOM	Flight Crew Operation Manual
FDM	Flight Data Monitoring
FMC	Flight Management Computer
ft	Feet
fpm	Feet per minute
Hrs	Hours
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
ILS	Instrument Landing System
kg	Kilogram
Kt	Knot
LDA	Landing Distance Available
LLZ	Localiser
m	Meters
MCP	Mode Control Panel
MEL	Minimum Equipment List
METAR	Meteorological Terminal Air Report
MSN	Manufacturer Serial Number
MTOW	Maximum Take Off Weight
NDB	Non Directional Beacon
OEM	Original Equipment Manufacturer

nm	Nautical Miles
PAPI	Precision Approach Path Indicator
PCN	Pavement Classification Number
PIC	Pilot in Command
RA	Radio Altitude
RESA	Runway End Safety Area
RWY	Runway
s	Seconds
SOP	Standard Operating Procedures
TODA	Take-off Distance Available
TORA	Take-off Run Available
TWR	Tower
VOR	VHF Omni directional Range
VHF	Very High Frequency
UTC	Universal Time Coordinated

SUMMARY

Serious Incident involving M/s Air Arabia A320 aircraft A6-AOT at Ahmedabad on 6 June 2022			
1.	Aircraft	Type	A320
		Nationality	UAE
		Registration	A6-AOT
		Country of Manufacture	France
2.	Owner	Wilmington Trust Company	
3.	Operator	Air Arabia	
4.	Pilot – in –Command	ATPL Holder	
5.	Co-Pilot	ATPL Holder	
6.	Place of Incident	Mumbai FIR	
8.	Last point of Departure	Chittagong	
9.	Intended place of Landing	Abu Dhabi	
10.	Date & Time of Incident	06 June 2022 at 1519 UTC	
11.	Passengers on Board	140	
12.	Extent of Injuries	Nil	
13.	Crew on Board	02 Pilots, 04 Cabin Crew	
14.	Extent of Injuries	Nil	
15.	Phase of Operation	Cruise	
16.	Type of Occurrence	System/Component Failure or Malfunction (Powerplant) (SCF-PP)	

(All the timings in this report are in UTC unless otherwise specified)

SYNOPSIS

On June 6th 2022, M/s Air Arabia aircraft planned a flight for sector Chittagong – Abu Dhabi with call sign ADY062. The flight was a scheduled passenger flight operated with an Airbus A320 type aircraft bearing registration A6-AOT.

The flight was operated by an ATPL holder PIC and a CPL holder Co-Pilot. The flight ADY062 departed from Chittagong airport at 1237 UTC.

While the aircraft was cruising at FL340, crew observed high N1 vibrations. Subsequently, Engine #1 failed. The crew carried out the ECAM actions and MAY DAY was declared. Thereafter, the aircraft was diverted to Ahmedabad. Aircraft landed at Ahmedabad at about 1545 UTC. No damage was reported to aircraft or on ground. None of the crew or passengers were injured.

The occurrence was classified as a Serious Incident as per Aircraft (Investigation of Accidents and Incidents) Rules, 2017. Investigation was ordered into the Serious Incident vide order no. INV-12012/1/2022-AAIB dated 13 June 2022, under Rule 11(1) of Aircraft (Investigation of Accidents and Incidents) Rules, 2017.

An accredited representatives from BEA France, the state of design and manufacture of the aircraft and its engines, and the state of registration of the aircraft, UAE participated in the investigation.

1. FACTUAL INFORMATION

1.1 HISTORY OF FLIGHT

On 06 June 2022, M/s Air Arabia planned a flight for sector Chittagong-Abu Dhabi with call sign ADY-062. The flight was a scheduled passenger flight operated with an Airbus A320-214 type aircraft bearing registration A6-AOT. The captain was the pilot flying, and the first officer was the pilot monitoring. They were assisted in the cabin by 04 Cabin Crew. The flight was operated under IFR conditions.

The aircraft has earlier in the day operated 02 flight from Khartoum to Abu Dhabi and Abu Dhabi to Chittagong. The occurrence happened during the 3rd flight of the day. The flight plan of the aircraft submitted to the Chittagong Airport Office was as follows:

ADY062_VGEG_220606_1132_OMAA

RECEIVED ABI/06-06-22 13:57:25

TAM6012 061357

FF VAAHAIDC

061357 VANPAIDC 2.002829-4.220606135723-5.92DB- (ABI-ADY062/A4776-VGEG-NINIM/1432F340-OMAA-8/IS-9/A320/M-10/SWYDE1FGHIJ1RZ/LB1V1- 15/N0463F340 DCT BPL L639 AGRIX L639 RASKI N881 KIPOL L444 TOLDA M628 TULBU Z855 SODEX N563 NOBTO-18/PBN/A1B1C1D1L1O1S2T1 COM/CPDLC DAT/VM DOF/220606 REG/A6AOT SEL/RSGQ CODE/8964DA RVR/075 OPR/ABY PER/C RMK/ADCKY895 ACASII EQUIPPED OCC CONTACT 97165088894 FIC1671)

As per ETLB, aircraft chocks off time recorded was 1228 UTC. After clearance from ATC, the aircraft lined up on runway 23 of Chittagong airport and took off at around 1237 UTC. After takeoff from Chittagong airport, the aircraft left the Dhaka airspace around 1304 UTC and came in contact with Kolkata ATC. As per the flight plan filed at Chittagong, the flight level selected for aircraft A6-AOT for the sector Chittagong Abu Dhabi was FL 340.

At approx. 1307 UTC, the Kolkata ATC assigned the FL340 to the aircraft. Crew acknowledged the instruction and started climbing to the assigned level. At 1404 UTC, Kolkata ATC asked the crew to switch over to Nagpur frequency 123.9 MHz. While the aircraft was at waypoint ASOPO, aircraft made contact with Nagpur ATC at 1405 UTC. Thereafter, Nagpur ATC asked the crew to proceed directly to waypoint NINIM.

At 1415 UTC, crew requested Mumbai ATC to grant clearance to climb altitude FL360 as weather was noticed on the current flight level on aircraft's weather radar. Subsequently, Mumbai ATC cleared the aircraft to climb to FL360. A boom sound was heard in the cockpit by both crews at approximately 1428 UTC while cruising at FL360.

As per the statement of PIC, the flight crew observed N1 vibration intermittently which reached upto 9.9 CU for a second and subsequently dropped to 2.5 CU. This occurred twice in succession and later ECAM warning "OIL FILTER CLOG" generated. Thereafter, crew followed the ECAM actions.

At about 1511 UTC, the first officer contacted Ahmedabad ATC and relayed the transmission "MAYDAY

MAYDAY MAYDAY Engine failure, descending 360 to FL250, right heading 300” when the aircraft was near waypoint LAXOM and, subsequently requested diversion to Ahmedabad. In response to this, Ahmedabad Tower Controller responded, “ROGER ROGER MAYDAY”. At 1513 UTC, the First Officer passed the information “passing FL340 and we request vectors for Ahmedabad and latest weather”. Ahmedabad ATC responded “Radar, ROGER MAYDAY turn left heading 050, vectoring for correction turn right heading 050 vectoring for ILS RWY23”. Thereafter, ATC asked the crew to affirm proceed direct to AAE. First officer acknowledged “Proceeding direct to AAE”. Crew again requested ATC to provide the latest weather. Subsequently, ATC provided the latest weather update to the aircraft at 15:15:19 UTC.

The First officer made the announcement on PA and informed passengers that due to engine failure; they are turning to Ahmedabad and meanwhile the cabin crew was instructed to secure the cabin. Thereafter, crew followed the approach Checklist.

Full emergency was declared by Ahmedabad airport at 1519 UTC and accordingly, the SOP was followed and all the concerned departments were informed. According to the Ahmedabad International Airport Occurrence report prepared post incident, two CFTs and one Ambulance was positioned on PDP (Planned Descend Point) at 1522 UTC. Additionally, One CFT along with another ambulance was positioned at Taxiway ‘F’ (Foxtrot). Airport’s two Operational Jeeps, #1 & #2, were also positioned (One at Taxiway ‘G’ and one at beginning of runway 23). Furthermore, the Ground Handling Agency was informed to arrange for a Pushback Tug, Towing arm and Headset Operator.

Ahmedabad ATC instructed aircraft to report preference of Approach. The First Officer responded “requesting ILS Z”. Subsequently, ATC controller acknowledged “ROGER”. Thereafter, RSR Controller had released the aircraft and instructed to contact Approach Radar 119.8 MHz.

At 15:41:27 UTC, while the aircraft was 9 Nm from the touchdown, Approach Radar Controller cleared the aircraft for ILS approach and instructed to contact Tower 119.6 MHz.

At 15:43:16 UTC, Tower controller cleared the aircraft for landing at runway 23 and passed the weather information wind 200 degrees 12 knots. The aircraft touched down safely on runway 23 at about 1544 UTC. After landing of aircraft, One CFT along with one ambulance followed the aircraft. Aircraft vacated runway 23 via Taxiway ‘C’ (Charlie). Follow me vehicle provided the assistance to the aircraft from Taxiway ‘G’ to Stand 42 and meanwhile MAYDAY warning was cancelled by the crew. At 1548 UTC, the full emergency was revoked and concerned departments were intimated.

As per ETLB, chocks on time recorded was 1550 UTC and the total flight duration was 3 hrs 08 minutes.

As part of the checklist, the fuel switch for the left engine was shut off. Cockpit Crew instructed the CCI to disarm the door and thereafter all the passengers deboarded the aircraft safely.

1.2 INJURIES TO PERSONS

There were no injuries.

1.3 DAMAGE TO AIRCRAFT

An inspection of the aircraft found no damage except to the No.1 engine, a CFM56-5B.

1.4 OTHER DAMAGE

There was no damage except to the engine.

1.5 PERSONNEL INFORMATION

1.5.1 PILOT IN COMMAND

Nationality	Australian
Age	56 Years 11 months
Date of Joining the Organisation	07 April 2022
License Type	ATPL
Date of issue of License	26 May 2022
Validity of License	25 May 2030
Category	Aeroplane
Endorsements as PIC	Captain
Date of Medical Exam	09 May 2022
Medical Validity	09 May 2023
FRTOL Date of Issue/Validity	26 May 2022
RTR Date of Issue/Validity	26 May 2022
Total Flying Experience	19783 hours
Hours Flown on Type	19346 hours on multi engine - no data on total hours on A320
Previous Flight (Date of Last Flight)	04.06.2022
Experience as PIC on Type	16167 hours on multi engine as PIC
Hours of flying at the time of incident	19829 hours
Hours flown in last 365 days	46.08 hours
Hours flown in last 180 days	46.08 hours
Hours flown in last 90 days	46.08 hours
Hours flown in last 30 days	46.08 hours
Hours flown in last 7 days	46.08 hours
Hours flown in last 24Hrs.	00
Previous incident history	Not involved in any serious incident/accident
Last Annual Line Check (ALC)	01 June 2022

PIC had a rest period of 37:32 Hrs before operating Chittagong-Abu Dhabi sector. He had completed his last Ground Refresher Training and Annual Line Check on 7 April 2022 & 01 June 2022 respectively. Further, the PIC had undergone last Proficiency Check on 10 May 2022.

1.5.2 FIRST OFFICER

Nationality	Pakistan
Age	28 years 3 months
Date of Joining the Organisation	20 Jan 2022
License Type	ATPL
Date of issue of License	08 Oct 2019
Validity of License	07 Oct 2027
Category	Aeroplane
Endorsements as PIC	First Officer
Date of Medical Exam	11 Oct 2021
Medical Validity	26 Oct 2022
FRTOL Date of Issue/Validity	20 June 2017
RTR Date of Issue/Validity	20 June 2017
Total Flying Experience	3384 hours
Hours Flown on Type	3314 hours
Previous Flight (Date of Last Flight)	05 June 2022
Experience as PIC on Type	None
Hours of flying at the time of incident	2260 hours
Hours flown in last 365 days	209.13 hours
Hours flown in last 180 days	209.13 hours
Hours flown in last 90 days	191.63 hours
Hours flown in last 30 days	64.55 hours
Hours flown in last 7 days	10.9 hours
Hours flown in last 24Hrs.	10.9 hours
Rest period before the flight	12 hours
Previous incident history	Not involved in any serious incident/accident
Last IR/PPC	31 Jan 2022
Last Annual Line Check (ALC)	13 March 2022
Last Ground Refresher	26 May 2022

The co-pilot had 20:35 Hrs of rest period before operating the Chittagong- Abu Dhabi sector. He had completed his Last Ground Refresher Training and Annual Line Check on 20 Jan 2022 & 13 March 2022 respectively. Further, the co-pilot had undergone last Proficiency Check on 23 Jul 2021.

1.6 AIRCRAFT INFORMATION

1.6.1 General Information: Airbus A320-214

Airbus A320-214 is a subsonic, medium-range, civil transport aircraft. The aircraft is powered by two high bypass turbofan engines on wing-mounted engine pods. The specified minimum cockpit crew to operate the aircraft is two. Aircraft Systems relevant to this incident are briefly discussed in subsequent paragraphs.

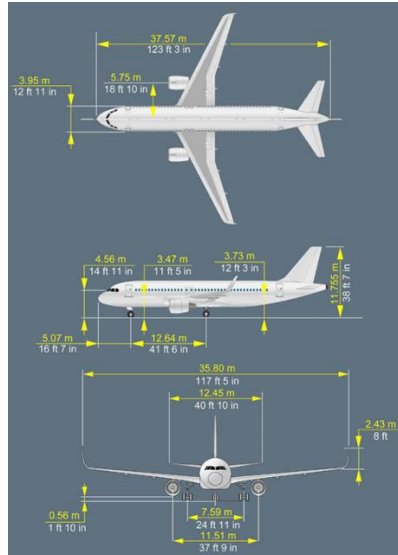


Figure 1: Aircraft Dimensions

1.6.1.1 Aircraft Engine:

The aircraft has two CFM International CFM56-5B engines that supply power to the aircraft. The engines are turbofan engines that have:

- A high bypass ratio,
- A Full Authority Digital Engine Control (FADEC),
- A fuel system,
- An oil system,
- An air system,
- A thrust reverser system,
- An ignition system and a start system.

The engine has:

- Two compressor turbine assemblies:
 - The Low Pressure (LP) compressor turbine assembly,
 - The High Pressure (HP) compressor turbine assembly.

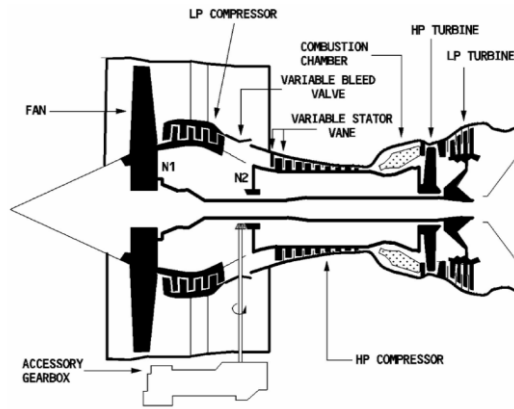


Figure 2

LP COMPRESSOR TURBINE ASSEMBLY

The LP compressor turbine assembly has One LP compressor, One LP shaft, One LP turbine. The LP shaft connects the LP compressor to the LP turbine. The LP compressor has a fan and 4 stages, and the LP turbine has 4 stages.

HP COMPRESSOR TURBINE ASSEMBLY

The HP compressor turbine assembly has One HP compressor, One HP shaft, One HP turbine. The HP shaft connects the HP compressor to the HP turbine. The HP compressor has 9 stages, and the HP turbine has a single stage.

COMBUSTION CHAMBER

The combustion chamber burns a mixture of fuel and High Pressure compressor air. The FADEC controls the fuel/air mixture in accordance with the position of the thrust lever and the aircraft operating conditions. The combustion chamber is an annular assembly with fuel nozzles and two igniters. The combustion chamber is between the HP compressor and the HP turbine.

1.6.1.2 MCDU

Post incidents, with the help of the MCDU, any system or component defect/failure occurred at any phase can be ascertained and accordingly maintenance action can be initiated.

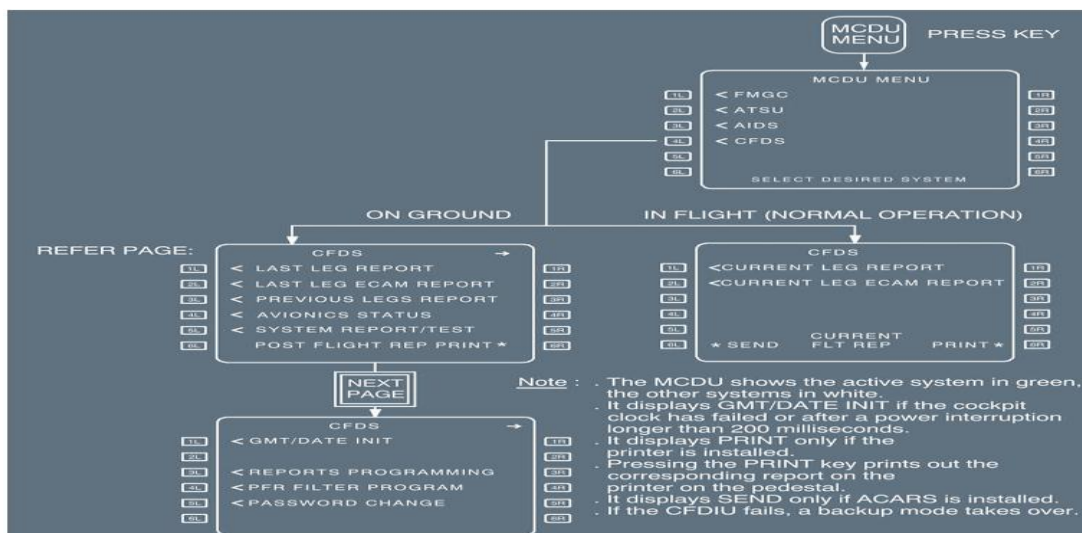


Figure 3

As per the Aircraft FCOM, the LAST LEG REPORT (on the ground) or the CURRENT LEG REPORT (in flight), list all class 1 failures and class 2 faults and all system failure and system fault messages received by the CFDS (CENTRALIZED FAULT DISPLAY SYSTEM) during the last flight leg or the current flight leg. Pressing the IDENT key displays a list of the systems (called identifiers) affected by the failure or fault, which helps the pilot or maintenance person to identify the failure or fault.

On ground, the CFDS present following maintenance reports:

- Last leg report
- Last leg ECAM report
- Previous leg report
- Avionics status
- System report test
- Post-flight report.

1.6.2 Aircraft Specific Information (A6-AOT)

Airbus had delivered the aircraft involved in this serious incident to Air Arabia Airlines on 3rd August, 2017; and record shows that the airplane was registered as A6-AOT and inducted in their fleet on 4 August 2017. The aircraft is registered under category 'Normal' with sub category 'Passenger' for day and night operation under VFR & IFR conditions.

Aircraft Model	A320-214
Aircraft MSN	7797
Year of Manufacture	03 August 2017
Name of Owner	WILMINGTON TRUST COMPANY
Certificate of Registration (C of R)	UAE-COR-1005
Certificate of Airworthiness (C of A)	UAE-COA-0491
Category	TRANSPORT PASSENGER
A R C issued	15 July 2021
ARC valid up to	02 August 2022
Aircraft Empty Weight	38472 Kg
Maximum Takeoff weight	77000 Kg
Date of last Aircraft weighing	04 July 2021
Operating Empty Weight	43359 Kg
Max Usable Fuel	18.9 Ton
Next Weighing due	04 July 2025
Total Aircraft Hours	19613:38 Hrs
Last major inspection	A check carried out on 28 May 2022
List of Repairs carried out after last major inspection till date of incident:	Nil
Engine Type	CFM56-5B
Date of Manufacture (LH Engine)	28 June 2017
Engine Sl. No. LH	729310
Last major inspection (LH)	Nil

List of Repairs carried out after last major inspection till date of incident:	Nil
Total Engine Hours/Cycles (LH)	19616:44 Hrs /6224 CSN
Date of Manufacture (RH Engine)	29 June 2017
Engine Sl. No. RH	729307
Last major inspection (RH)	Nil
List of Repairs carried out after last major inspection till date of incident:	Nil
Total Engine Hours/Cycles (RH):	19616:44 Hrs /6224 CSN
Aero mobile License	AE17-00080-01
AD, SB, Modification complied (LH ENGINE):	Found complied on the day of incident
AD, SB, Modification complied (RH ENGINE):	Found complied on the day of incident

1.6.2.1 Engine Maintenance Events

As per the records shared by operator, CFM56- 5B Engine with ESN 729310 was originally installed on the aircraft A6-AOT and since then it was never removed for any shop visit till the Engine IFSD incident occurred on 6 June 2022. The engine was maintained as per the MPD and all the mandatory scheduled inspections and tasks were followed accordingly. As per the records, in last 5 years, a total of 3 events of engine tailpipe fire after shutdown were reported on the involved engine. These events were reported on 10 Sept 2021, 25 Jan 2022 and 26 Feb 2022.

After each of those events, TSM was followed and troubleshooting actions were carried out. The aircraft was released to service after the replacement of damaged oil inlet cover assemblies. No other parts/components were replaced in the exhaust area during those maintenance activities.

As per Air Arabia, Engine health is monitored on weekly basis where engine health reports are provided by Power Plant Development department. Last one month report of the involved engine was checked and 'Nil' observation was found regarding the Engine #1 High N1 vibration except the PIREP report of 5th June 2022.

On 5th June 2022, as per PIREP (Pilot reporting) "ENGINE NUMBER 1 VIBRATION N1 FLUCTUATION BETWEEN 1.4 AND 2.2 IN CRUISE FROM TOP OF CLIMB TO TOP OF DESCEND". After this incident, the troubleshooting was carried out in accordance with TSM and OPS test of FADEC for both channels was also carried out as per the AMM. Test passed and no fault was recorded. Last leg report on both channels A & B, no faults recorded. Nil PFR messages, EVMU last leg Nil records and self-test passed. However, it was suggested to crew to monitor this parameter during subsequent flights and report further.

The aircraft and its engines were being maintained as per the GCAA approved 'Aircraft Maintenance Program' consisting of calendar period/ flying hours or cycles. All inspections (Pre-flight checks, Extended Transit, A Checks) were carried out as and when due before the incident.

1.7 METEOROLOGICAL INFORMATION

The METARs issued for Ahmedabad airport at around the time of accident, and subsequent diversion

till the aircraft landed at runway 23 were as follows:

Time (UTC)	Winds	Visibility	Clouds	Temp (°C)	QNH	Forecast
1500	210/12 Kt	4000 m FU	NSC	36	1002	NOSIG
1530	200/12 Kt	4000 m FU	NSC	36	1003	NOSIG

Table 3: Meteorological Data

As per the reported weather conditions, no significant weather forecast was recorded at around time of serious incident in Ahmedabad.

1.8 AIDS TO NAVIGATION

Following Navigation Aids are available at Ahmedabad International Airport (VAAH) as per the AIP.

Type of Aids	Identification	Frequency (ies), Channel number(s)	Hours of operation	Geographical coordinates	Elevation of transmitting antenna
1	2	3	4	5	6
LOC23	IAHD	110.300 MHz	H24	230349.52002N 0723712.19069E	---
GP23	IAHD	335.000 MHz	H24	230514.52701N 0723837.00225E	---
DME ILS 23	IAHD	CH40X	H24	230514.34606N 0723836.91467E	211 FT
MKR	AH	215.000 K Hz	H24	230829.0N 0724158.8E	
DVOR	AAE	113.100 MHz	H24	230405.63215N 0723744.69617E	---
DME	AAE	CH78X	H24	230405.48453N 0723744.14526E	218 FT

Table 4: Nav Aids available at Ahmedabad

1.9 COMMUNICATIONS

Aircraft made contact with RSR unit of ATC Ahmedabad on VHF frequency 123.75 MHz at 1510 UTC approximately. At 1526 UTC, aircraft was handed over to ASR unit on frequency 119.8 MHz and thereafter, aircraft was assisted in landing by TWR on frequency 119.6 MHz. The aircraft maintained positive contact with ATC till end of the flight. The transcript of relevant communication with ATC is tabulated below:

Unit: RSR

Frequency: 123.75 MHz

TIME	TRANSMISSION
15:11:41	AMD CONTROL ADY062 MAYDAY MAYDAY MAYDAY ENGINE FAILURE DESCENDING 360 TO F250 RIGHT HEADING 300
15:11:52	ADY062 RADAR ROGER TURN RIGHT HEADING 300 ROGER MAYDAY
15:12:48	ADY062 RADAR
15:12:51	ADY062 STANDBY
15:13:28	AH.. ADY062 MAYDAY PASSING 340 AND WE REQUEST VECTORS FOR AHMEDABAD AND LATEST WEATHER

15:13:38	ADY062 RADAR ROGER. ROGER MAYDAY TURN LEFT HEADING 050 VECTORIZING FOR CORRECTION TURN RIGHT HEADING 050 VECTORIZING FOR ILS APPROACH RWY23
15:13:52	ADY062 RADAR
15:13:53	ROGER RIGHT HEADING 050 VECTORIZING ILS APPROACH 23 ADY062
15:14:00	ADY062 RADAR AFFIRM PROCEED DIRECT TO AAE NOW
15:14:06	PROCEEDING DIRECT AAE ADY062
15:14:25	ADY062 RADAR REPORT TOTAL PERSONS ON BOARD AND ENDURANCE
15:14:27	AH WE ARE TOTAL 146 ON BOARD 140 PASSENGERS 6 CREW STANDBY FOR ENDURANCE
15:15:00	ADY062 RADAR PROCEED DIRECT AAE REPORT ETA AHMEDABAD
15:15:06	AHMEDABAD ADY062 ENDURANCE 3 HOURS
15:15:10	ADY062 RADAR ROGER COPIED
15:15:12	AND SIR REQUEST LATEST WEATHER FOR AHMEDABAD PLEASE
15:15:19	ADY062 LATEST AHMEDABAD WEATHER TIME 1500 WIND 210 DEGREE 12 KNOT VIS. 4000 M IN SMOKE NSC TEMPERATURE 36 DEW POINT 24 QNH1002 TREND NOSIG
15:15:38	COPIED VIS. 4000 IN SMOKE QNH 1007 ADY062
15:15:59	ADY062 RADAR
15:16:00	GO AHEAD
15:16:02	CONFIRM READY FOR FURTHER DESCEND
15:16:04	AFFIRM WE ARE READY FOR DESCEND
15:16:06	ADY062 RADAR ROGER DESCEND TO F160
15:16:10	DESCEND F160 ADY062
15:17:31	ADY062 RADAR CONFIRM LEFT ENGINE FAILURE OR RIGHT ENGINE FAILURE
15:17:35	LEFT ENGINE FAILURE ADY062
15:17:36	ADY062 RADAR ROGER COPIED
15:17:42	ADY062 RADAR DESCEND TO F100
15:17:44	DESCENDING F100 ADY062
15:21:03	ADY062 RADAR REPORT PREFERENCE OF APPROACH
15:21:07	REQUESTING ILS Z ADY062
15:21:09	ADY062 RADAR ROGER EXPECT RADAR VECTORED ILS Z APPROACH RWY23
15:21:13	ROGER RADAR VECTORED ILS Z ADY062
15:24:18	ADY062 RADAR FLY HEADING 085 VECTORIZING FOR ILS Z APPROACH RWY 23
15:24:23	CONFIRM HEADING 085 FOR ADY062
15:24:28	ADY062 AFFIRM FLY HEADING 085 VECTORIZING FOR ILS Z APPROACH RWY 23
15:24:34	COPIED 085 ILS Z RWY23 ADY062
15:25:52	ADY062 CONTACT APPROACH RADAR 119.8
Transmissions in bold are from Controller	

Communication held with ASR unit on frequency 119.8 MHz

15:37:11	ADY062 RADAR VIS. 4000 M CONFIRM VISUAL APPROACH ACCEPTABLE
15:37:17	NEGATIVE WE WILL GO FOR ILS ADY062
15:37:20	ROGER
15:38:17	ADY062 RADAR TURN RIGHT HEADING 100
15:38:19	RIGHT HEADING 100 ADY062
15:39:33	ADY062 RADAR TURN RIGHT HEADING 125 POSITION 15 MILES FROM TOUCHDOWN
15:39:40	RIGHT HEADING 125 ADY062

15:40:29	ADY062 RADAR TURN RIGHT HEADING 195 TO INTERCEPT LOCALISER
15:40:35	RIGHT HEADING 195 TO INTERCEPT LOCALISER RWY23 ADY062
15:41:23	LOCALIZER RUNWAY 23 ADY062
15:41:27	ADY062 9 MILES FROM TOUCHDOWN CONTACT TOWER 119.6
15:41:32	CONFIRM CLEARED FOR THE ILS ADY062
15:41:35	ADY062 AFFIRM CLEARED FOR ILS APPROACH RWY 23 CONTACT TOWER 119.6
15:41:40	CLEARED FOR ILS ADY062 GOOD DAY
Transmissions in bold are from Controller	

Communication held with TWR unit on frequency 119.6 MHz

15:41:46	AHMEDABAD TOWER ADY062 MAYDAY ESTABLISHED FINAL ILS RWY23
15:41:54	ADY062 AHMEDABAD TOWER RWY23 CLEARED TO LAND WIND 200 DEGREES 12 KNOTS
15:42:05	COPIED RWY23 CLEARED TO LAND ADY062
15:42:23	ADY062 WILL BE STOPPING ON RWY ADY062
15:42:30	COPIED
15:43:14	CONFIRM CLEARED TO LAND ADY062
15:43:16	ADY062 TOWER AFFIRM RWY23 CLEARED TO LAND WIND 200 DEGREES 12 KNOTS
15:43:23	COPIED ADY062 CLEARED TO LAND
15:46:12	ADY062 VACATING C
15:46:16	ADY062 APPROVED
15:46:42	ADY062 YOU CAN GIVE US ANY STAND
15:46:46	ADY062 TAXI VIA G TAXI VIA C G STAND 42 FOLLOW FOLLOW ME JEEP
15:46:56	OKAY TAXI VIA C G STAND 42 FOLLOW FOLLOW ME ADY062
15:47:34	ADY062 AHMEDABAD TOWER TAXI VIA C G STAND42 FOLLOW FOLLOW ME JEEP
15:47:44	COPIED C G STAND 42 FOLLOW FOLLOW ME ADY062
15:47:48	ROGER
15:48:45	TOWER ADY062 DISREGARD WE ARE CANCELLING MAYDAY
Transmissions in bold are from Controller	

1.10 AERODROME INFORMATION



Figure 4 : Arodrome layout – Satellite Image

The IATA location Identifier code is AMD and ICAO location Indicator code is VAAH for Sardar Vallabhbhai Patel International Airport (SVPIA), Ahmedabad. The airport is authorized for VFR/IFR operations. The airport is located at an elevation of 57.6 m AMSL. The Airport Reference point coordinates are 23°04'16.3" N latitude and 72° 37' 35.1" E longitude. The Rescue & Fire

Fighting Services of Category 9 is available within ATC watch hours at Ahmedabad airport.

Runway characteristics and declared distances are shown in the following tables.

Runway Physical Characteristics					
Runway Designator	Threshold Co-ordinates	Runway Dimensions(m)	Strip Dimension(m)	RESA (m)	Threshold Elevation(feet)
05	230357.45 N 0723720.66 E	3505 X 45	3625 X 280	90 X 90	180
23	230518.48 N 0723847.25 E	3505 X 45	3625 X 280	90 X 90	189

Table 5: Runway Characteristics

Runway Declared Distances					
Runway Designator	Take-off Available (m)	Run (TORA) (m)	Take-off distance available (TODA) (m)	Accelerate stop distance available (ASDA) (m)	Landing Distance Available (LDA) (m)
05	3505		3505	3505	3505
23	3505		3505	3505	3505

Table 6: Runway Distances

1.11 FLIGHT RECORDERS

The aircraft A6-AOT was equipped with Flight Data Recorder and Cockpit Voice Recorder. The Flight Recorders were removed from the aircraft at Ahmedabad after the occurrence. The download of data was carried out by AAIB and the units were released to the Operator. DFDR raw data of the incident flight was made available to BEA, France. Further, recording of all the four channels was available in the CVR and was available for investigation.

1.11.1 DIGITAL FLIGHT DATA RECORDER

The raw DFDR data was downloaded by AAIB and datafile A6-AOT FDR 20-06-22 was shared with BEA through a secured file sharing on 24th June 2022. The aircraft manufacturer Airbus provided the associated decoding data frame, referenced f1024facf022, and the data analysis report was made available to AAIB by BEA, France. In the FDR, the last recorded flight was dated 6th June, which was coherent with the event date. It is further corroborated from the fact that during inflight engine # 1 failure occurred and this was deduced from the engine parameters variation. This allowed to confirm that the last recorded flight in the FDR file corresponds to the flight of the event.

The factual information retrieved from the FDR is tabulated below:

UTC time	Pressure Altitude CAS	FDR factual information	Comment
Take-off from RWY 23 Chittagong airport (Bangladesh)			
12:36:52		ENG #1 N1 vibrations increased to 3.1 CU while the ENG 2 N1 vibrations stayed around 0.7 CU.	During the previous flight, the level of Eng #1 N1 vibrations was quite similar, as it was around 2.5 CU during cruise.

12:37:27	292 ft 164 kt	All gears were uncompressed. Pitch was 10.2° nose up, and altitude started to increase.	
12:40:00		ENG #1 N1 vibrations started to oscillate between 0.5 CU and 2.6 CU.	
Cruise			
13:10:41	33 964 ft 270 kt	Aircraft reached its cruising altitude. Altitude track mode activated. Selected altitude was FL 340. The oscillations on the ENG #1 N1 vibration parameter increased in frequency but the amplitude stayed approximately the same.	
13:41:33	34 000 ft 267 kt	The oscillations on the ENG#1 N1 vibration parameter faded off.	
14:00:50	33 968 ft 267 kt	There was no longer oscillations on the ENG #1 N1 vibration parameter. The ENG #1 N1 vibration level remained steady around 2.5 CU.	
14:15:14	33 996 ft 268 kt	Selected altitude increased to FL 360. Altitude started to increase. Climb mode activated.	
14:19:17	35 964 ft 258 kt	Altitude track mode activated. Selected altitude was FL 360.	
ENGINE 1 FAILURE			
15:06:03	36 016 ft 258 kt	ENG #1 N2 rotation speed decreased from 94.25% to a minimum of 91.88%, and was no longer equal to ENG 2 N2.	
15:06:06	36 012 ft 258 kt	ENG #1 oil pressure decreased from 43 psi to 40 psi while the ENG 2 oil pressure stayed constant at 43 psi.	Confirmation with Safran Aircraft Engines that at that moment there was an engine stall, visible with the decrease of N1 and N2, fuel flow and oil pressure, and in particular the decrease of PS3. Engine stall was recovered.
15:06:07	36 028 ft 258 kt	ENG #1 PS3 decreased from 118 PSI to 71.5 PSI. ENG #1 N1 vibrations, which were around 3 CU, increased rapidly to 9.9 CU. At the same time, ENG 1 EGT increased from 644°C to 696°C. ENG 2 EGT stayed around 635 °C. During 1 second, ENG 1 N1 and N2 rotation speeds dropped, before increasing back. ENG 1 fuel flow increased from 1220 kg/h to 1290 kg/h. ENG 1 N2 vibrations increased from 0.4 CU, up to 2.4 CU.	After the engine stall was recovered, the EGT and fuel flow were higher, due to damage of the engine vane.

15:06:10	36 008 ft 258 kt	The alarm ENG #1 N1 vibration advisory was active for 5 seconds.	
15:06:16	36 008 ft 258 kt	ENG #1 N1 vibrations reduced to 2.4 CU. ENG 1 EGT started to increase.	
15:06:40	36 000 ft 257 kt	Engine page was displayed for 16 seconds.	
15:07:08	35 984 ft 258 kt	ENG #1 N1 vibrations increased to 9.9 CU and the alarm ENG #1 N1 vibration advisory was active during 3 seconds. At the same time and during 1 second there was a drop of ENG 1 N2. ENG 1 oil temperature started to increase.	
15:07:15	35 988 ft 258 kt	ENG #1 N1 vibration reduced to 2.3 CU.	
15:09			<u>PFR message</u> ENG 1 OIL FILTER CLOG
15:09:03	36 028 ft 260 kt	Master caution was active for 4 seconds. Engine page was displayed for 20 seconds.	
15:10			<u>PFR message ENG 1 STALL (2)</u>
15:10:23	35 992 ft 258 kt	At the same time, ENG #1 N1 and N2 dropped. Suddenly, N1 vibration increased to 9.9 CU, and the alarm ENG #1 N1 vibration advisory activated. ENG #1 N2 vibration started to increase from 2.4 CU to 9.9 CU. ENG #1 fuel flow dropped from 1305 kg/h to 428 kg/h. ENG 1 oil pressure and ENG #1 PS3 started to decrease. Both engine throttles stayed at 24° (CLIMB).	
15:10:28	35 968 ft 258 kt	Master caution was active during 2 seconds.	
15:10:39	35 964 ft 253 kt	ENG #1 throttle lever decreased from 24° (CLIMB) to 0° (IDLE).	
15:10:47	35 972 ft 250 kt	Master caution activated up to 15:11:25, with some pauses.	
15:10:57	35 960 ft 248 kt	ENG #2 throttle lever increased from CLIMB to FLEX/MCT.	
15:11			<u>PFR messages ENG 1 FAIL</u> <u>AFS:28V PWR 11XU1 ELEC GEN 1</u> <u>FAULT</u>
Descent			
15:11:16	35 992 ft 241 kt	Selected altitude decreased to FL 330.	
15:11:19	35 992 ft 240 kt	Descent mode activated.	
15:12			<u>PFR messages</u> ENG 1 EGT OVER LIMIT ENG 1 SHUT DOWN

15:12:36	34 504 ft 246 kt	ENG #1 EGT overlimit activated for 12 seconds. Master caution activated. Then ENG #1 EGT started to decrease.	
15:12:40	34 456 ft 246 kt	ENG #1 master lever was set to OFF.	
Landing on RWY 23 at Ahmedabad airport (India)			
15:44:59	412 ft 121 kt	Both main landing gears were compressed.	

As per FDR data, no fire warning was generated during the flight and crew managed to land the aircraft safely at Ahmedabad airport at 15:44:59 UTC.

The post flight report generated after the flight revealed that the first event message pertaining Engine system “ENG 1 OIL FILTER CLOG” was registered at 1509 UTC when the aircraft was in cruise phase. At 1510 UTC, the second event “ENG 1 STALL (2)” got registered and after one minute, at 1511 UTC the next event “ENG 1 FAIL” was registered. Two events “ENG 1 EGT OVER LIMIT” & “ENG 1 SHUT DOWN” both were registered at 1512 UTC.

Printed: 13/06/2022

Title: Flight Details

Leg	-10	Flight Number	G962	A/C ID	A6-AOT
From	CGP	First Event Date	06 Jun 22 - 12:44		
To	AMD	Last Event Date	06 Jun 22 - 16:29		

CMS:PFR_TAB

Phase	Date Time	ATA	Source	Title	Subtitle	Class	Occurrence History	Priority	Dispatch Message	Work	Note
06-CRUISE	06 Jun 22 - 15:09	7700		[ENG 1 OIL FILTER CLOG]			.....x		false		
06-CRUISE	06 Jun 22 - 15:10	7700		[ENG 1 STALL(2)]			.....x		false		
06-CRUISE	06 Jun 22 - 15:11	7700		[ENG 1 FAIL]			.....x		false		
06-CRUISE	06 Jun 22 - 15:12	7700		[ENG 1 EGT OVER LIMIT]			.....x		false		
06-CRUISE	06 Jun 22 - 15:12	7700		[ENG 1 SHUT DOWN]			.....x		false		
				[null]					false		
06-CRUISE	06 Jun 22 - 15:11	242255	AFS 1	[AFS:28V PWR 11XU1]			..x...x...x...x		false		YES
				[null]					false		
06-CRUISE	06 Jun 22 - 15:11	2400		[ELEC GEN 1 FAULT]			.....x		false		
				[null]					false		

Table 7: PFR Data

FDR data was utilized to prepare the FDR Plots encompassing significant events occurred during the flight and they are attached as Annexure ‘A’ to this report.

1.11.2 COCKPIT VOICE RECORDER

As per the aircraft FCOM, the CVR variant installed on the aircraft retains last 2 hours of recording and it records the following:-

- Direct conversations between crew members in the cockpit
- All aural warnings sounded in the cockpit
- Audio communications received and transmitted
- Intercommunications conversations between crew members
- Announcements transmitted over the PA system, if PA reception is selected on at least one audio control panel.

After the incident, the CVR was downloaded and the content of CVR was checked. CVR recorded all the four channels and recording quality was satisfactory. The relevant portion of the CVR is provided

in Annexure 'B' of this report.

Analysis of Cockpit voice recorder confirmed that all the applicable SOPs to be followed after the engine failure were followed by the crew.

1.12 WRECKAGE AND IMPACT INFORMATION

At 1511 UTC, MAYDAY was declared, and thereafter aircraft performed a single engine landing at Ahmedabad airport safely.

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

Not relevant to the flight.

1.14 FIRE

No fire reported pre or post landing.

1.15 SURVIVAL ASPECTS

The serious incident was survivable and none of the passengers or crew were injured.

1.16 TESTS AND RESEARCH

1.16.1 Engine Teardown Inspection

The strip examination was carried out at OEM's facility in Morocco, and detailed examination of various components and modules were carried out later at Labs. The figure 5 below shows cross section of Engine and aft sump area.

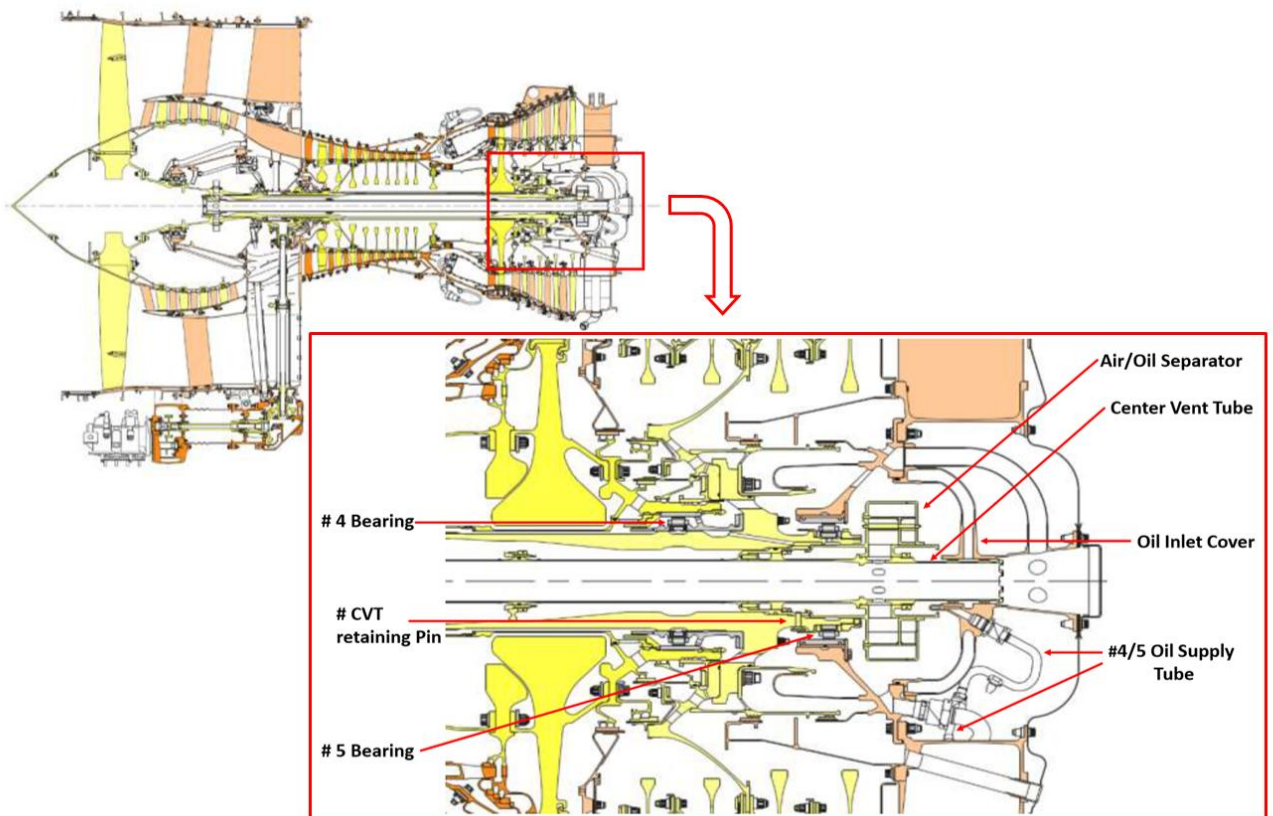


Figure 5

The observations made during the Strip examination of engine and detailed component examinations relevant to the investigation follows.

1. HPT Blades were found with heavy rubbing and the HPT rear shaft was damaged.

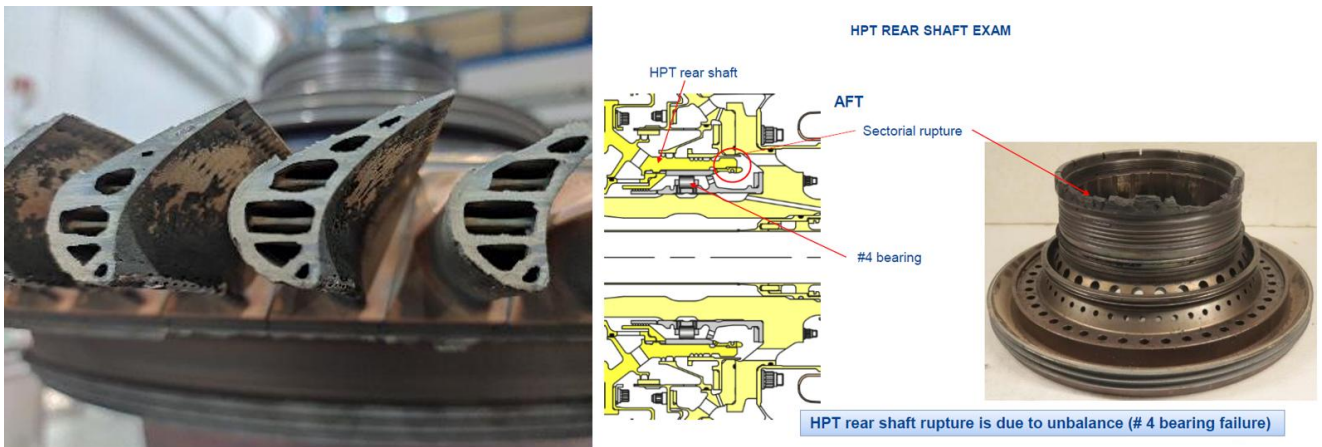


Figure 6

2. LPT nozzle guide vanes were observed with distress signs. Vanes from 6 to 8 o'clock position were severely burnt. LPT 2 Nozzle guide vanes were fully burnt.



Figure 7

The correlation of damages on LPT stator vanes with Fuel Nozzle's flow distribution or observations on Combustion Chamber does not indicate any significant linking. The distress and damages were likely caused due to excessive fuel flow during engine roll back.

3. Rubbing marks were found on LPT shaft.



Figure 8

4. LPT #4 bearing was found damaged. No. 4 roller bearing was subjected to detailed examination. The failure was characterized by the heavy metallization of the inner and outer ring tracks, rolling elements and cage with the presence of melted deposits of metal and silver, a dull grey aspect of the rollers as well as an important diameter reduction for some of the rollers and the absence of prior fatigue cracking-rupture of the cage spacers which allow to rule out a degradation mode by primary spalling of the track(s) and/or the rollers.



Figure 9



Figure 10



Figure 11

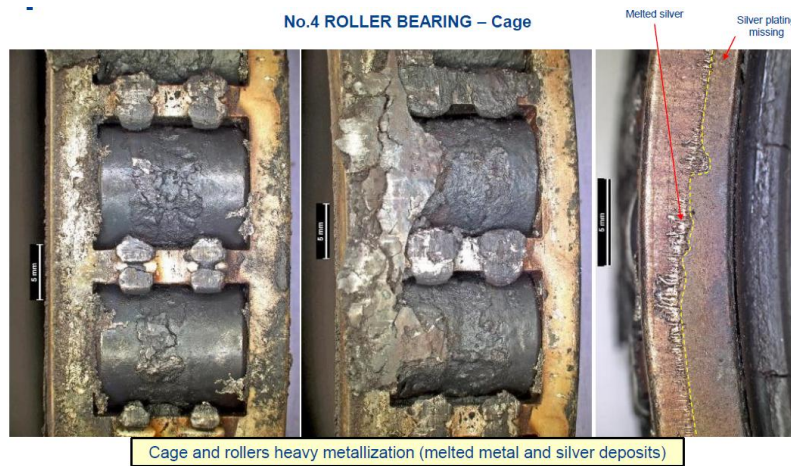


Figure 12



Figure 13

On micrographic cut section, performed through the least damaged roller, a microstructural aspect (both on surface and in the core) corresponding to a totally overheated material condition – overheated aspect also consistent with the measured hardness: ~70 HRC measured for a BP prescription between 60 and 64 HRC.

Those findings, in relation to the relatively long time accumulated by this bearing before failure (19613h/6224cy) suggest a lubrication deficiency issue also supported by the presence, on the outer raceway and rollers, of reddish deposits of oxidized wear products.

5. #5 Roller bearing were in general good condition. However, traces of coked oil particles and particles made of ZxWC10 (No.4 roller bearing) and Inco 718 were present on the rollers.



Figure 14

6. Oil scavenge nipple Air/Oil inlet cover had deformation, dents, thread damage which could cause oil leak. Burnt oil deposit were observed on the nipple. Particle matter was found in the bearing of oil scavenge nipple.

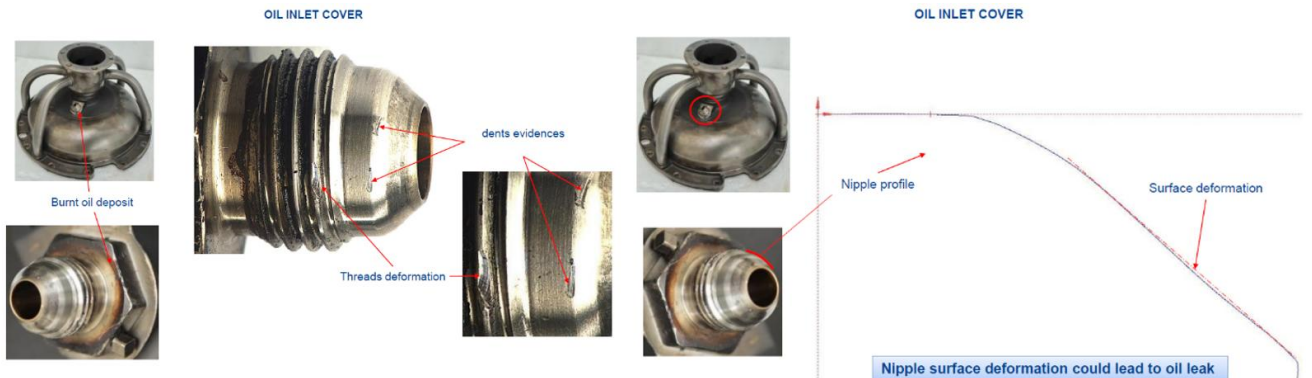


Figure 15



Figure 16

7. Center Vent Tube (CVT) was displaced until the Air Oil Separator came into abutment with the oil inlet cover. Contact between Air/oil Separator and Oil Inlet cover caused imprints of CVT seals and wear.



Figure 17

AIR OIL SEPARTOR/ OIL INLET COVER CONTACT EVIDENCES

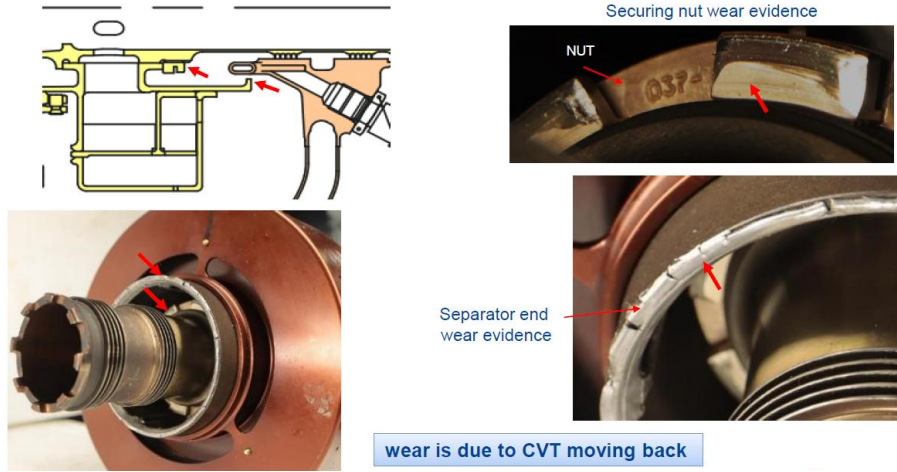


Figure 18

CENTER VENT TUBE EXAM

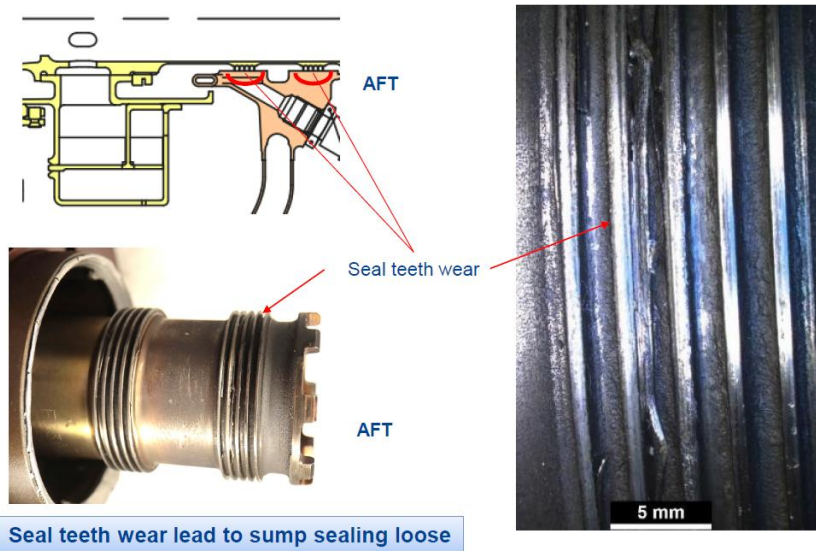


Figure 19

CENTER VENT TUBE EXAM

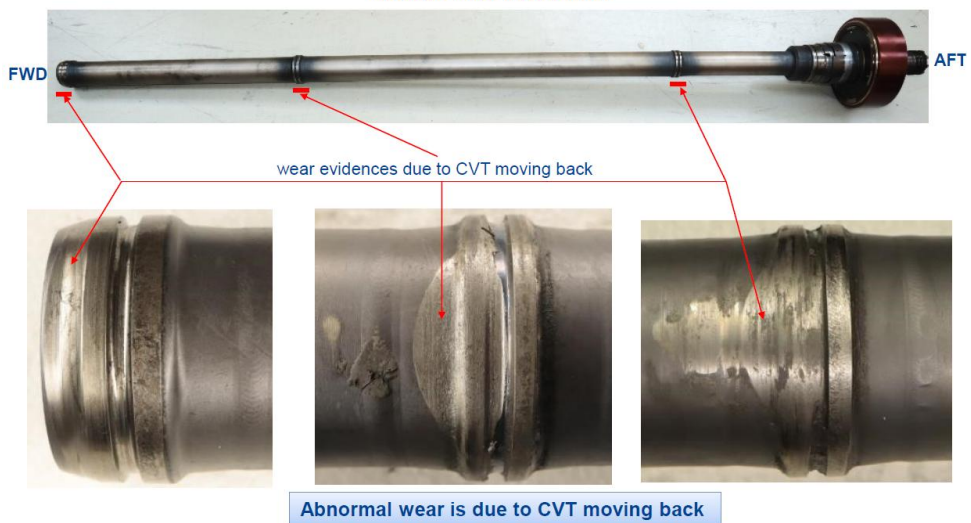


Figure 20

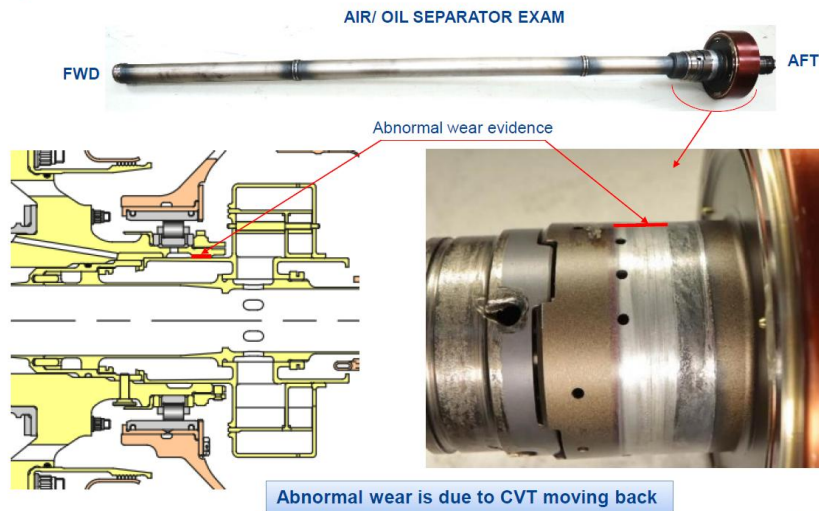


Figure 21

This progressive move back is also characterized by 3 retaining pins damaged but in place in the LPT shaft and escaping CVT holes which are also deformed and worn. Wear evidences on the CVT center zones confirms some operation time in the retracted position.



Figure 22



Figure 23

As per the OEM's report, CVT move back is at the origin of failure sequence, and stall occurred after #4 bearing failure. Axial movement of CVT and condition of CVT retaining holes and pins cannot be inspected in line maintenance but can only be inspected during shop maintenance.

8. Damages and wear were observed on the #4 and 5 Oil Supply Tubes. Weld metal on the tube thermal shield had ruptured.

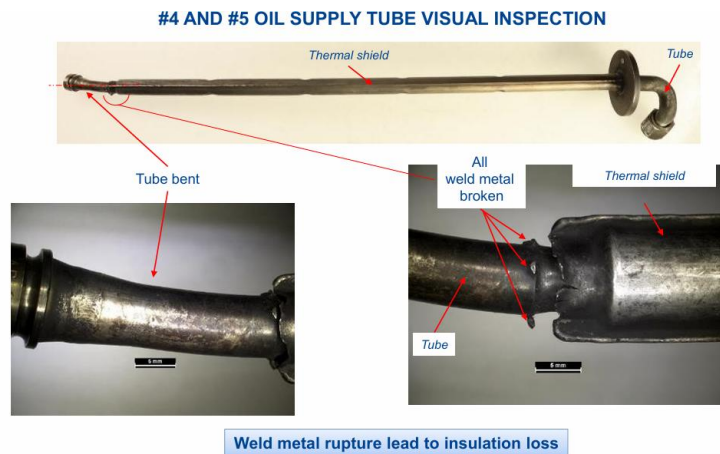


Figure 24

There was loss of Thermal insulation.



Figure 25

Loss of thermal shield caused cokefaction, leading to coke deposit on inner tube surface. This caused reduction in inner tube diameter. As per the information available from OEM, the engine design allows a 30% reduction without degradation of bearings, therefore, the impact of this section reduction on the oil flow inside the tube and consequently on the lubrication of bearing #4 was determined as marginal.

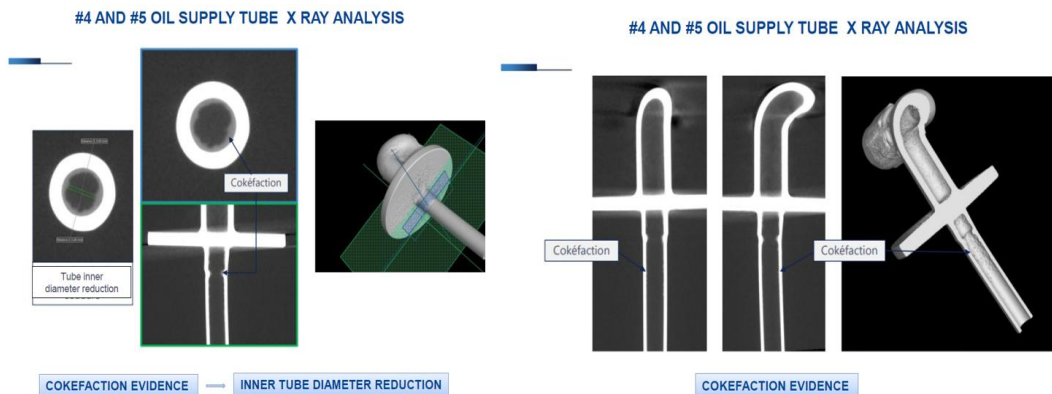


Figure 26

9. Nipple deformations were observed on #4 and #5 Oil Supply pipeline along with scratch evidence on the nipple. These abnormality could cause oil leak which was evident from burnt oil deposit and cokefaction.

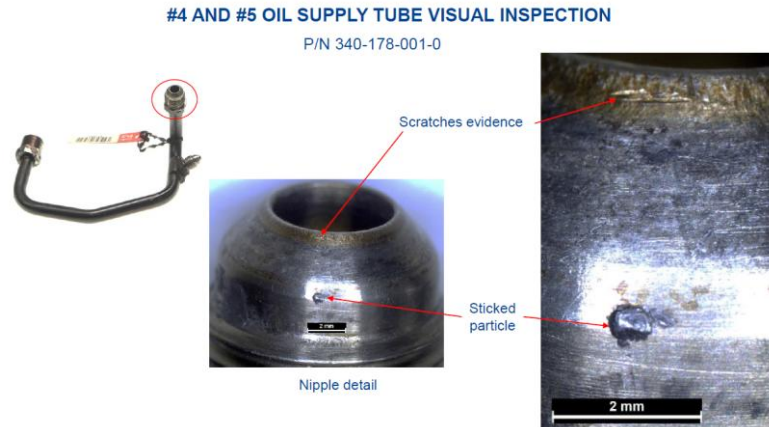


Figure 27

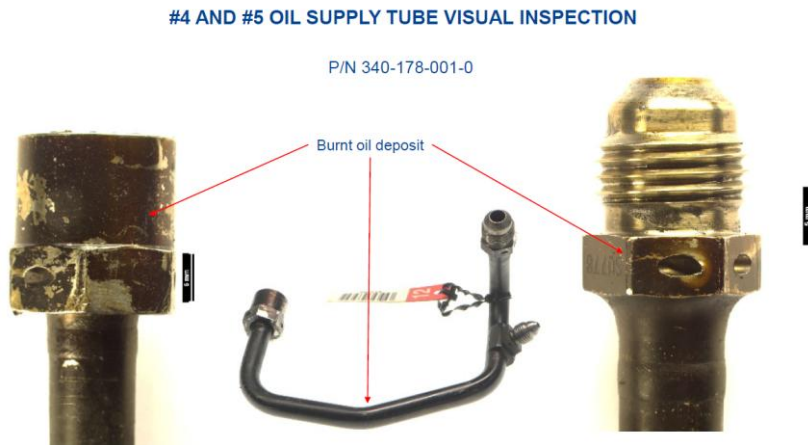


Figure 28

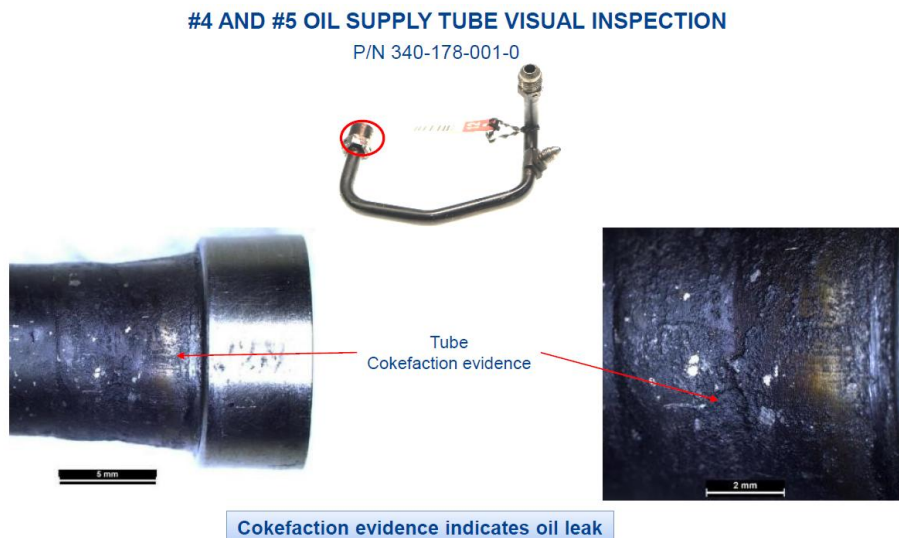
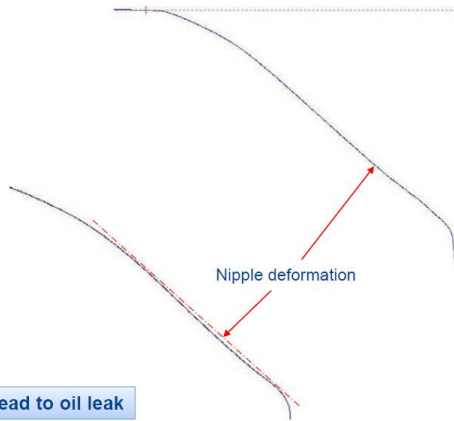


Figure 29

#4 AND #5 OIL SUPPLY TUBE GEOMETRICAL INSPECTION

P/N 340-178-001-0

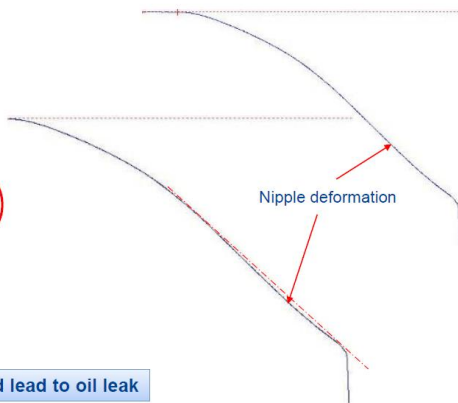


Nipple deformation could lead to oil leak

Figure 30

#4 AND #5 OIL SUPPLY TUBE GEOMETRICAL INSPECTION

P/N 340-178-001-0



Nipple deformation could lead to oil leak

Figure 31

P/N 340-178-001-0



Nozzle deformation could lead to oil leak

Figure 32

1.17 ORGANIZATIONAL AND MANAGEMENT INFORMATION

Air Arabia is an Emirati airline with its head office and main base at the Sharjah International Airport, United Arab Emirates (UAE). It was established on 3 February 2003 as a low-fare airline in the Middle East. The airline started operations on 28 October 2003. At the time of incident, the airline had 68 aircrafts in its fleet comprising of different variants from the same manufacturer i.e. Airbus.

The organizational structure of the Air Arabia Airline is presented below:

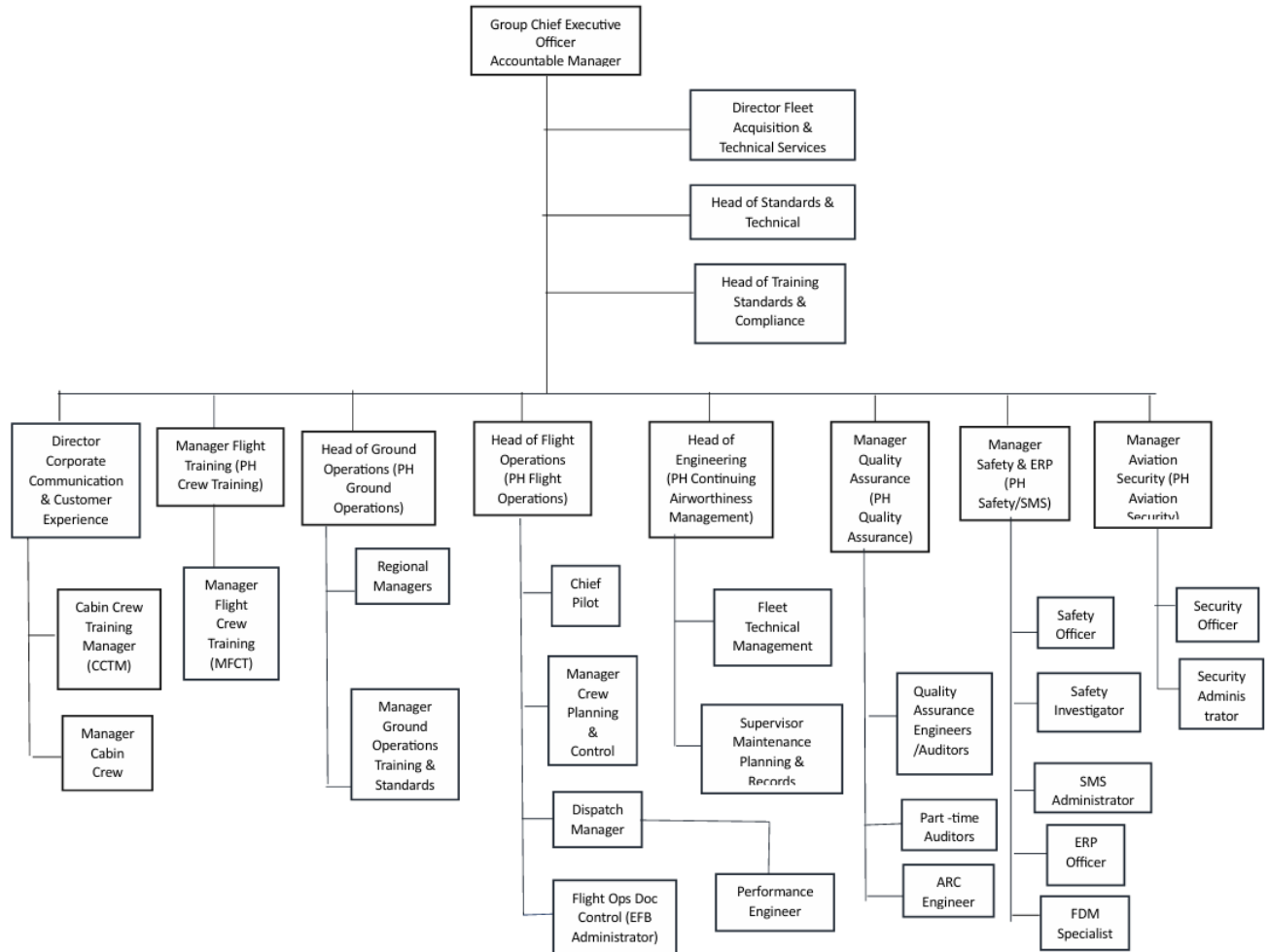


Figure 33: Organisation Chart

1.17.1 FCTM

On the day of incident, FLIGHT CREW TECHNIQUES MANUAL issued by M/s Air Arabia dated 02 JUN 22 was applicable.

As stated in the FCTM, it provides complementary information to the Flight Crew Operating Manual (FCOM). The FCTM provides the flight crew with:-

- The general Airbus operational philosophy (e.g. design and utilization principles, golden rules for pilots)
- Additional information to the FCOM procedures (the “why” to do and the “how” to do)
- Best practices, operating techniques on maneuvers, and handling
- Information on situation awareness.

1.17.1.1 ENGINE VIBRATIONS

In their FCTM, the company has given the scenario when the engine may encounter vibrations. Further, the FCTM has also stipulated the guidelines crew has to follow whenever they observe such vibrations in the cockpit. The relevant content from the FCTM- ABNORMAL AND EMERGENCY PROCEDURES on 'Engine Vibrations' is given below:

"Engine vibrations are usually caused by an imbalance of the engine that can be due to many reasons such as:

- A deformation of one or several blades due to Foreign Object Damage (FOD), or a bird strike
- A rupture or a loss of one or several blades
- An internal engine failure (e.g. engine stall)
- A fan icing

High engine vibration alone does not require an engine in-flight shutdown. If the engine needs to be shutdown, other symptoms and certainly an ECAM alert will warn the flight crew, and request them to shut down the engine.

A high N1 vibration level may be accompanied by perceivable airframe vibrations.

When the vibration level exceeds a certain threshold, the ECAM advisory function automatically highlights the affected parameter. When the flight crew identifies high engine vibrations, the flight crew must refer to the ECAM ADVISORY CONDITIONS section of the QRH. This section guides the flight crew to the QRH HIGH ENGINE VIBRATION procedure.

In the case of high engine vibrations, the flight crew first checks the engine parameters, and crosschecks them with the other engine. The flight crew identifies if there are engine vibrations only, or if there is another problem on the engine for which the flight crew may expect an ECAM alert.

If the flight crew does not suspect icing, and if flight conditions permit, the flight crew reduces thrust to make the vibrations decrease, and stay below the advisory threshold.

If the vibrations do not decrease, there may be another problem with the engine. The flight crew should expect an ECAM alert that will provide guidance on the actions to perform."

1.17.1.2 ENGINE STALL

FCTM has also discussed about the cause and symptoms of engine stall. The procedures and guidelines outlined in the FCTM and which crew has to follow during Engine Stall are provided below:

"An engine stall is the disruption of the airflow in a turbine engine. When the blades of the engine compressors stall, they are no longer able to compress the air from the front to the rear of the engine. In some cases, there may be a breakdown of the airflow, with the high-pressure air at the end of the compressor reversing flow, and exiting from the front of the engine. If this occurs, it may result in an immediate and significant loss of thrust.

From the flight crew perspective, the engine stall is one of the most startling events at takeoff or during flight. The engine stall should not take the flight crew away from their primary task that is to fly the

aircraft.

An engine stall can be due to any of the following reasons:

- An engine degradation (e.g. compressor blade rupture, or high wear)
- Ingestion of foreign objects (e.g. birds), or ice
- A malfunction of the bleed system
- A malfunction of the engine controls (e.g. fuel scheduling, or stall protection devices)
- A significant disturbance of the airflow (e.g. due to wake turbulence, non-appropriate use of the thrust reverser after landing, or lightning strike).

During cruise, and at low power settings (e.g. at thrust reduction at the T/D), the symptoms of an engine stall are the following:

- One or more muffled bangs
- Slow or no thrust lever response
- Fluctuations of the engine parameters (EPR/N1, N2, or N3). The engine may give the impression to pump
- An increase of the EGT
- Engine vibrations
- Acrid smell in the cockpit

Most of the FADECs have functions that:

- Regulate the airflow through the compressor, to prevent engine stalls
- Are able to detect engine stalls
- Try to recover from an engine stall, without flight crew action, by modifying the airflow.

When the FADEC detects an engine stall, the FADEC requests that the ENG 1(2) STALL ECAM alert is triggered.

The FADEC is not able to detect an engine stall in all cases. Therefore, if the flight crew detects one or a combination of the engine stall symptoms, the flight crew should suspect an engine stall, and apply the QRH Engine Stall procedure.

The Engine Stall procedure is not a memory item. Therefore, if a stall occurs during the cruise phase, the flight crew shall take the time to assess the situation before applying the procedure, as most of the times the FADEC will self-recover from the stall before any flight crew action. The Engine Stall procedure (ECAM or QRH) is as follows:

-When the flight crew has stabilized the aircraft trajectory, the flight crew first reduces thrust to idle on the affected engine.

This action reduces the differential pressure across the compressor. This helps the engine airflow to become more stable.

- When at idle thrust, the flight crew checks the stability of the engine parameters on the EWD, and particularly the EPR/N1, EGT, N2, and N3. The flight crew should also check the engine vibrations on the ENG SD page.

- The flight crew shuts down the engine if:

- The fluctuations of the engine parameters, or the high EGT, or the engine vibrations persist, or
- The symptoms of the engine stall persist at idle thrust.”

1.17.1.3 ENGINE TAILPIPE FIRE

The content from FCTM on Tail pipe fire is reproduced below:

“An engine tailpipe fire can only occur at engine start or at engine shutdown. It is the result of an excess of fuel in the combustion chamber, in the turbine or in the exhaust nozzle, that ignites. A tailpipe fire is an internal fire in the engine, compared with an engine fire that occurs outside the engine core and gas path. No critical areas are affected in the engine in the case of a tailpipe fire. However, it can have an effect on the aircraft (e.g. damage the flaps). The correct method to manage an engine tailpipe fire is to stop the fuel flow, and to ventilate the engine. In the case of a tailpipe fire, there is no cockpit alert. The only indication can be an increasing EGT due to the fire in the turbine. Therefore, most of the time, the ground crew, cabin crew, or ATC visually detect the tailpipe fire.

In the case of a tailpipe fire, the flight crew must apply the QRH ENG TAILPIPE FIRE procedure, which requires the flight crew to:

- Shut down the engine, in order to stop the fuel flow
- Dry crank the engine, to remove the remaining fuel

The flight crew should not use the ENG FIRE pb (Push Button). This cuts off the electrical supply of the FADEC, and stops the dry crank sequence performed by the FADEC. The flight crew should not use the fire extinguisher, as it does not extinguish an internal engine fire. As a first priority, the fuel flow must be stopped, and the engine must be ventilated.”

According to Safran, a tail pipe fire can also result from an oil leakage that accumulates in the exhaust plug, which can induce fumes or flames. According to Safran’s experience, tail pipe fires on CFM56 engines are more often resulting from an oil leakage rather than from excess of fuel in the combustion chamber.

1.18 ADDITIONAL INFORMATION

1.18.1 EMERGENCY PROCEDURES CHECKLISTS

Air Arabia’s Operations Manual (dated 2nd June, 2022), QRH included checklist procedures for High engine vibrations, engine stall, engine fail, engine shutdown, engine tailpipe fire, Engine EGT overlimit and Oil low pressure occurring on the ground or in flight. These checklists are provided in the FCOM’s Abnormal and Emergency Procedures containing detailed actions to be taken immediately in response to the emergencies. The checklists applicable to aircraft MSN 7797 are placed at Annexure: C.

1.19 USEFUL OR EFFECTIVE INVESTIGATION TECHNIQUES

Nil.

2. ANALYSIS

2.1 SERVICEABILITY OF AIRCRAFT

Aircraft Log book revealed that as on 6th June 2022, aircraft completed 19623:18 Hrs (TSN)/ 6227 Cycles while the left engine completed 19613:38 Hrs (TSN)/ 6224 Cycles. The Engine #1 which was originally fitted on the aircraft was never removed for any shop visit as it was neither due for any major overhaul nor involved in any other incident during its service. However, the involved engine encountered 3 events of tailpipe fire. During these events TSM was followed and aircraft was released after engine's on wing maintenance activities.

The scrutiny of records, made available to investigation team, revealed that M/s Air Arabia maintained the aircraft as per the Aircraft Maintenance Program approved by their GCAA. There was no record of any pending snag or deferred maintenance action on involved engine that could have contributed to the incident. Further, aircraft records revealed that ADs, SBs and all mandatory modifications were found complied at the time of incident.

2.1.1 Aircraft Engine

The engine #1 IFSD resulted from total failure of No. 4 roller bearing during the flight. The strip examination and further analysis carried out on different components of involved engine suggests that due to lack of lubrication resulting into less heat dissipation led to failure of No. 4 roller bearing. This is established based on finding of heavy metallization of the inner and outer rings tracks, rolling elements and cage with the presence of melted deposits of metal and silver. Further, some of the roller's diameter reduced and no prior fatigue cracking-rupture of the cage spacers was observed ruling out a degradation mode by primary spalling of the track(s) and/or the rollers. The micrographic examination of the least worn roller, both on surface and core, indicated overheating condition of the rollers despite showing hardness within BP limits.

Factors which could have contributed to the No. 4 roller bearing lubrication deficiency and consequential failure were observed by the OEM during its investigation. Visual inspection and X-Ray revealed lack of thermal shield inside No. 4 and No. 5 oil supply tube which resulted into cokefaction deposit and reduction of inner diameter of the oil supply tube. However, the impact of this section reduction on the oil flow inside the tube and consequently on the lubrication of bearing #4 was determined as marginal. On the No. 4 roller bearing oil supply tube, Nipples were also deformed or had threads damaged. A particle was also located at entry of # 4 roller bearing oil supply tube.

The Center Vent Tube (CVT) got displaced during the flight. This move back of CVT is characterized by 3 retaining pins damaged but found in place in the LPT shaft. CVT pin holes were also found deformed and worn. OEM has also observed some wear evidences on the CVT center zones which confirms some operation time in the retracted position. The dislocation of CVT from its installed position also led to a loss of lubrication of the No.4 bearing inner race.

As per the OEM, the elongation of pin holes can be caused by operational loads (centrifugal loads, vibrations, thermal stresses, etc). Excessive elongation can allow a pin to move outside of the hole of the CVT tube. In that case, CVT is no longer retained axially and can generate damage to the pin. Axial movement of CVT and condition of CVT retaining holes and pins, however, cannot be inspected in line maintenance but can only be inspected during shop maintenance.

oil temperature started increasing. After 07 seconds, ENG #1 N1 vibrations reduced to 2.3 CU.

Consequent to Engine #1 oil filter clogging at 1509 UTC, Master caution activated in the cockpit and Engine page displayed for around 20 seconds.

As per PFR message, Engine #1 encountered stall at around 1510 UTC. At the same time, ENG #1 N1 and N2 dropped, N1 vibration reached upto 9.9 CU and the advisory alarm ENG #1 N1 vibration activated. ENG #1 N2 vibration also started to increase from 2.4 CU to 9.9 CU. A significant drop in fuel flow from 1305 kg/h to 428 kg/h for ENG #1 is observed. During this time, although both engine throttles stayed at 24° (CLIMB), oil pressure and PS3 of ENG #1 started decreasing. Again, this resulted into activation of Master caution for 2 seconds.

Subsequently, crew decreased ENG #1 throttle lever from 24° (CLIMB) to 0° (IDLE) while the aircraft was at 35,964 feet at 253 knots. Thereafter, Master caution remained active up to 15:11:25 UTC, with some pauses. The Flight Crew re-configured the thrust of ENG #2 by increasing the throttle lever from CLIMB to FLEX/MCT.

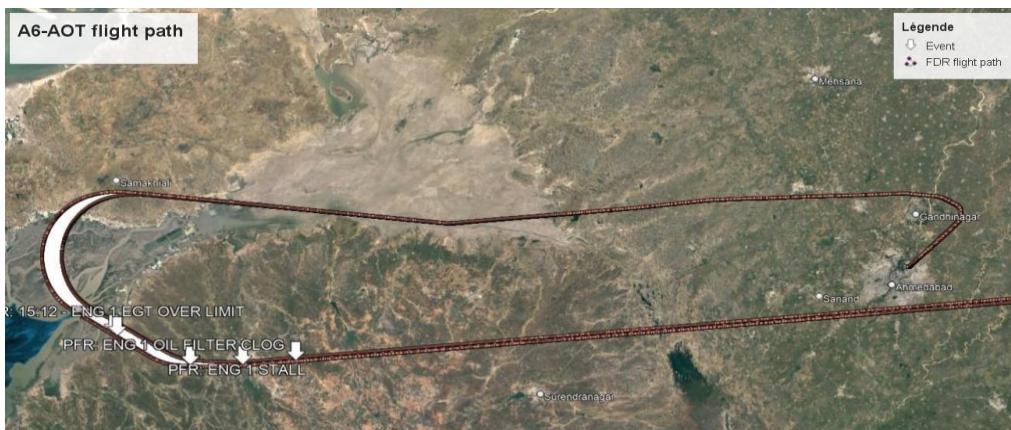


Figure35: Aircraft Flight path depicting main Events

Aircraft flight path along with inflight events occurred, before the aircraft landed at Ahmedabad airport, are projected on Google Earth based on DFDR's data.

At 1511 UTC, the Flight Crew decided to decrease the altitude by selecting FL330 and descend mode was activated. Thereafter, at 1512 UTC, again ENG #1 EGT overlimit alarm and Master caution activated. Thereafter, the Flight Crew followed the FCOM and ENG #1 master lever was set to OFF.

The Flight crew requested Ahmedabad ATC for direct routing and carried out a Visual Approach as required by their SOP. The Flight Crew established the Landing Configuration after carrying out all related Checklists. The aircraft touchdown on runway 23 at Ahmedabad airport at 1544 UTC.

2.3 DECISION TO PERFORM EMERGENCY CHECKLISTS

CVR recording revealed that the flight crew noticed boom sound around 1428 UTC subsequently after the selection of FL 360 at 1415 UTC. At that moment, both crew had even discussed about N1 and N2 vibrations. DFDR data showed that N2 rotational speed of left engine (Engine #1) no longer remained equal to right engine (Engine #2) at 1506 UTC, and it dropped from 94.25 % to 91.88 %. In addition to this, all other parameters related to Engine such as oil pressure, PS3, fuel flow and N1 also dropped simultaneously indicating engine stall at that moment.

The 'Engine Stall' checklist contained in FCOM and included in the QRH also states that crew must

bring the throttle lever to 'IDLE' and check the affected engine's parameters when instructed by ECAM, or if crew detects an engine stall before FADEC.

If crew observes abnormal ENG parameters then Engine Master (affected engine) be selected to 'OFF' and subsequently, the ENG shutdown ECAM procedures must be applied.

DFDR revealed that despite of no throttle lever movement at this point of time, engine stall was recovered. However, during stall, the Engine #1 N1 vibrations reached 9.9 CU resulting into activation of advisory alarm for 5 seconds and display of Engine page for 16 seconds. As per the FCOM checklist 'High Engine Vibration', the VIB advisory on ECAM ($N1 \geq 6$ units) is mainly a guideline for the flight crew to monitor engine parameters more closely and reduce thrust if conditions permit, it does not require engine shut down.

At 1508 UTC, the Engine #1 N1 vibrations again started increasing and reached upto 9.9 CU and advisory alarm got activated for 3 seconds. This time engine oil temperature also started increasing. However, after elapse of 7 seconds, engine vibrations subsided and reached to 2.3 CU. PFR downloaded after the incident revealed that the first message registered in the system was 'Engine 1 oil filter clog' at 1509 UTC. As per the FCOM 'OIL FILTER CLOG' alert (Annunciation in the cockpit) triggers when the oil filter is clogged. Subsequently, Master caution got activated and Engine page was again displayed. Aircraft was flying at a speed of 260 knots when this caution was generated.

The second fault code captured by the system was 'ENG 1 STALL' and as per PFR, this was logged at 1510 UTC, one minute after the first fault 'oil filter clog' was captured by the aircraft system. According to FCOM, an alert triggers in the cockpit when an engine stall is detected by the FADEC system. This phenomenon has following consequences during the flight; varying degree of abnormal engine noises/bangs, accompanied by flame from the engine exhaust, fluctuating performance parameters, vibration, sluggish or no thrust lever response, high EGT and/or a rapid EGT rise when thrust lever is advanced. As discussed earlier, FCOM checklist 'ENG 1(2) STALL' has clearly suggested that crew must bring the throttle of affected engine to its 'IDLE' position when the aircraft is in flight. However, no such action by crew is observed from DFDR.

At 15:10:23 UTC, approximately 23 seconds after the second fault 'Engine Stall' was logged into the system, rotational speed of both N1 and N2 were found dropping. This time vibrations of both sections exceeded and first time reached upto 9.9 CU simultaneously. This led to advisory alarm activation and a significant drop in fuel flow. Engine 1 oil pressure and PS3 also started decreasing but the engine throttle stayed at 24 degree (Climb). And the aircraft speed was 258 knots. During this period, Master caution again got activated for 2 seconds. About 16 seconds after this, at 15:10:39 UTC, the crew decreased the throttle lever to 'IDLE'. Thereafter, crew followed the SOP and throttle lever of Engine #2 changed from 'CLIMB' to 'FLEX/MCT' at 15:10:57 UTC. CVR recording revealed that during this moment, crew declared the MAY DAY and decided to decrease the altitude from FL360 to FL250.

According to PFR message, three faults were logged simultaneously by the aircraft system at 15:11 UTC, including fault 'ENG 1 FAIL'. And other two faults captured were '28 V PWR 11XU1' and 'ELEC GEN 1 FAULT'. According to FCOM, an annunciation regarding Engine failure gets triggered when the engine core speed is below idle, with the ENG MASTER lever set to ON, and ENG FIRE pb not pushed.

Further, the FCOM clearly states that engine flame out due to engine failure may be recognized by a rapid decrease in EGT, N2, FF followed by decrease in N1. In addition to this, further symptoms to suspect engine damage are also provided in the FCOM. The crew can suspect engine damage if two or more of the following symptoms are observed: rapid increase of EGT above the red line, important mismatch of the rotor speeds, significant increase of aircraft vibrations and/ or buffeting and repeated or uncontrolled engine stalls. As per the 'ENG FAIL' checklist, crew must apply the 'ENG SHUT DOWN' checklist procedure, if engine damage is suspected. At 15:11:16 UTC, crew decided to lower the altitude and FL330 was selected and descent mode activated.

According to the PFR messages, two other faults 'ENG 1 EGT OVERLIMIT' and 'ENG 1 SHUT DOWN' were also logged into the aircraft system at 1512 UTC. As per FCOM, whenever EGT exceeds 950 °C when the thrust levers are at TOGA or FLX/MCT position, or 915 °C in other cases, an annunciation is generated in the cockpit. According to the FCOM, under these conditions, crew must apply the procedures laid down in the checklist 'ENG N1/N2/ EGT OVER LIMIT'. The throttle lever must be brought to 'IDLE' and in second step, Engine Master switch of the affected engine must be set to 'OFF' position. Further, the checklist instructs the crew to follow the associated procedures and implement Engine Shut down procedure.

FDR data showed that the crew selected the ENG 1 master lever to 'OFF' position at 15:12:40 UTC. This is corroborated with CVR recording, which captured communication held between the cockpit crew discussing about the engine master switch at approximately the same time. Thereafter crew followed the descent, approach and landing checklist and managed to land the aircraft safely at Ahmedabad airport.

2.4 CIRCUMSTANCES LEADING TO THE INCIDENT

Engine #1 was originally fitted on the aircraft and had never undergone any major overhaul or shop visits. However, the engine had experienced three tailpipe fire events in Sept 2021, Jan 2022 and Feb 2022 prior to the incident flight.

Post-event maintenance followed the Trouble shooting Manual (TSM) and the Oil inlet cover was replaced on each occasion. The TSM task for Engine tailpipe fire however, did not have requirement to check CVT position to detect absence of axial movement. The axial movement of CVT can block oil path to #4 bearing if left unchecked.

The engine dis-assembly and examination after the incident flight confirmed that the CVT holes had got elongated and the CVT retaining pins had also got worn out. During the incident flight, the CVT could no longer be retained by the worn pins and elongated holes and moved sufficiently backwards so as to cause blockage of oil path to #4 bearing leading to its degradation.

This degradation caused increased level of vibration and initiation of stall event when the crew heard continuous boom sound for a while in the cockpit, at which time the airplane's airspeed was 258 knots and throttle lever was set to 'CLIMB'.

Despite transient recovery after initial stall indications, the degraded # 4 bearing failed and caused

HPT rear shaft rupture, resulting in shaft imbalance and damage to HPT & LPT blades. This led to severe engine vibrations, drop in few engine parameters (N1, N2, oil pressure, fuel flow), and subsequently failure of left engine.

Although the throttle lever was already set to 'IDLE' but due to HPT shaft imbalance and consequent damage of turbine blades, master caution 'ENG FAIL' was generated in the cockpit. Thereafter, crew followed the checklist and Engine Master was selected to 'OFF' and engine was secured.

3. CONCLUSION

3.1 FINDINGS

3.1 The Certificate of Airworthiness, Certificate of Registration and Airworthiness Review Certificate of the aircraft were valid on the date of incident and the aircraft was airworthy. No evidence indicated any structural, or system failures before the aircraft's left engine failure occurred.

3.2 Flight crew were medically fit and their licenses were current to operate the flight.

3.3 During previous flight sector, aircraft's left engine (Engine # 1) had once experienced vibrations of around 3.1 CU while the aircraft was flying at cruise altitude.

3.4 During incident flight, aircraft was flying at its cruise altitude, FL 340, when the left engine again experienced vibrations. Thereafter, Engine #1 N1 parameter started oscillating & vibrations reached upto 2.5 CU.

3.5 Based on weather radar data, to avoid turbulence, crew selected FL 360. And when the climb mode was activated to attain FL360, aircraft's left engine N2 speed started decreasing and thereafter, was no longer equal to N2 speed of aircraft's other engine (Engine #2).

3.6 The left engine of aircraft stalled during climb resulting in decrease of engine's vital parameters such as Oil pressure, fuel flow and PS3. Crew had also experienced continuous stall booms for few seconds in the cockpit.

3.7 As per the DFDR data, three advisory alarms Engine #1 N1 vibration and two Master Caution warning got activated before crew followed the checklist and throttle of left engine was decreased from 24 (CLIMB) to 0 (IDLE).

3.8 After release by Mumbai ATC controller, crew established contact with ATC Ahmedabad and declared 'MAYDAY' due to Engine failure.

3.9 Full emergency was declared at Ahmedabad airport. All the concerned departments were informed and every assistance was provided by the airport operator until the aircraft reached safely to parking bay.

3.10 Boroscopic inspection carried out at Ahmedabad airport confirmed significant damage to both HPT and LPT blades due to severe vibrations.

3.11 Detailed engine examination at OEM facility revealed source of engine vibration, reaching upto 9.9 CU, was due to failure of left engine's No. 4 roller bearing inflight. And the cause of failure of No. 4 roller bearing was due to lubrication deficiency issue.

3.12 During strip examination, Centre Vent Tube (CVT) was also found displaced and this backward

movement of CVT also led to more loss of lubrication of No. 4 bearing inner race. This is further confirmed from the presence of melted deposits of metal and silver on both rolling element and cage, heavy metallization of the inner and outer rings tracks and reduction of diameter for some of the rollers.

3.13 There were three repeated tail pipe fire incidents on the Engine in Sept 2021, Jan 2022 and Feb 2022 before the incident flight and oil inlet cover was replaced each time.

3.14 The TSM task in case of Tail Pipe fire did not have any requirement to check CVT position to detect absence of axial movement, which could block oil path to #4 bearing if left unchecked.

3.15 Full LPT 2nd stage nozzle guide vanes of left engine burned during IFSD due to engine roll back.

3.16 After IFSD, the captain made a timely decision to declare MAYDAY and diverting the aircraft to the nearest available airport in accordance with company training and procedures.

3.2 PROBABLE CAUSE

The probable cause of this serious incident was the failure of No. 4 roller bearing resulting in severe vibration of left engine and consequently leading to failure of both HPT and LPT blades. Lack of sufficient lubrication, when the CVT dislodged from its installation, led to too high temperature and failure of No. 4 bearing.

Contributory factors:

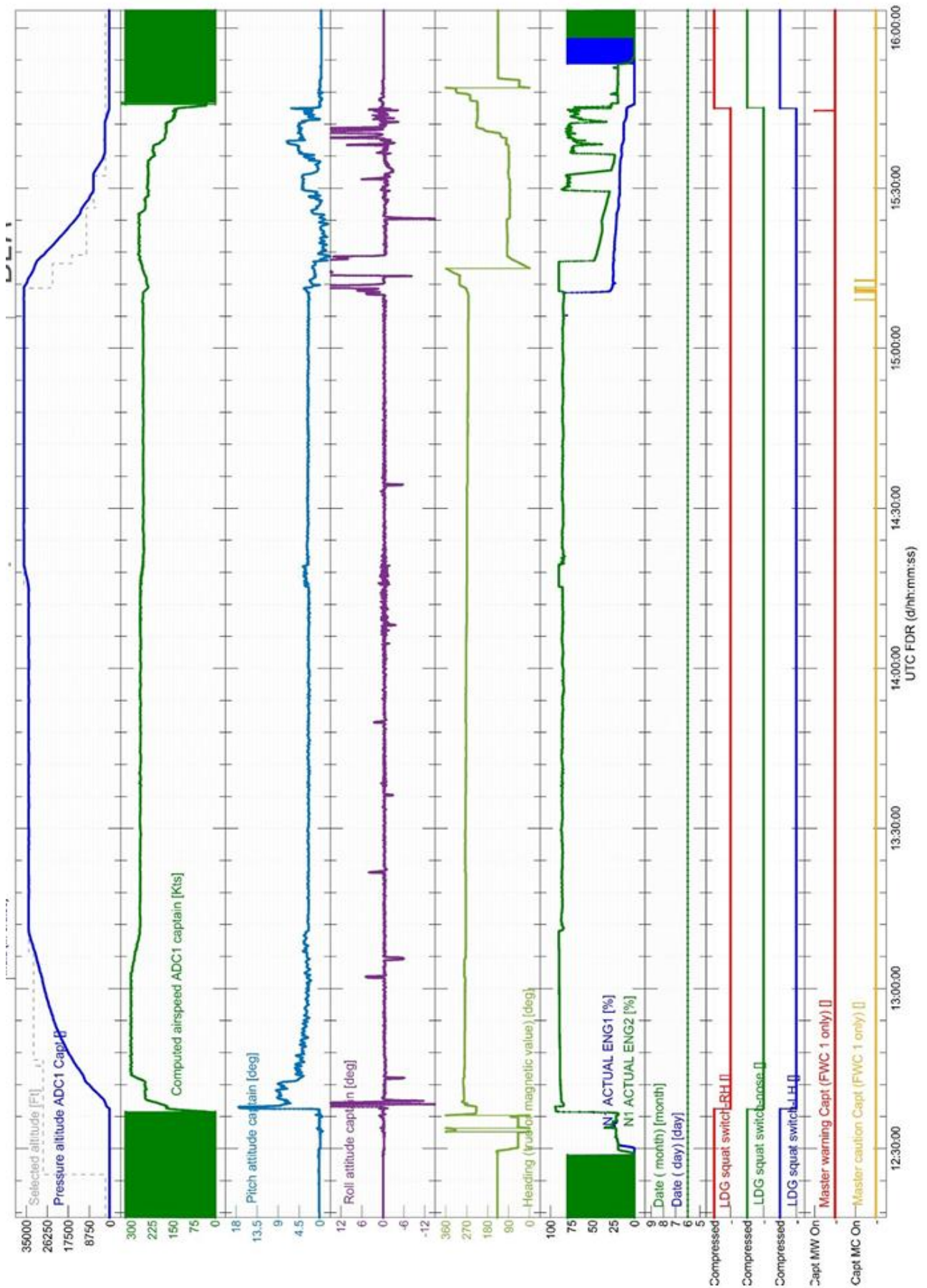
1) Crews' perception of no damage to engine delayed ECAM actions and procedures resulted into late response of bringing back the throttle lever to 'IDLE'.

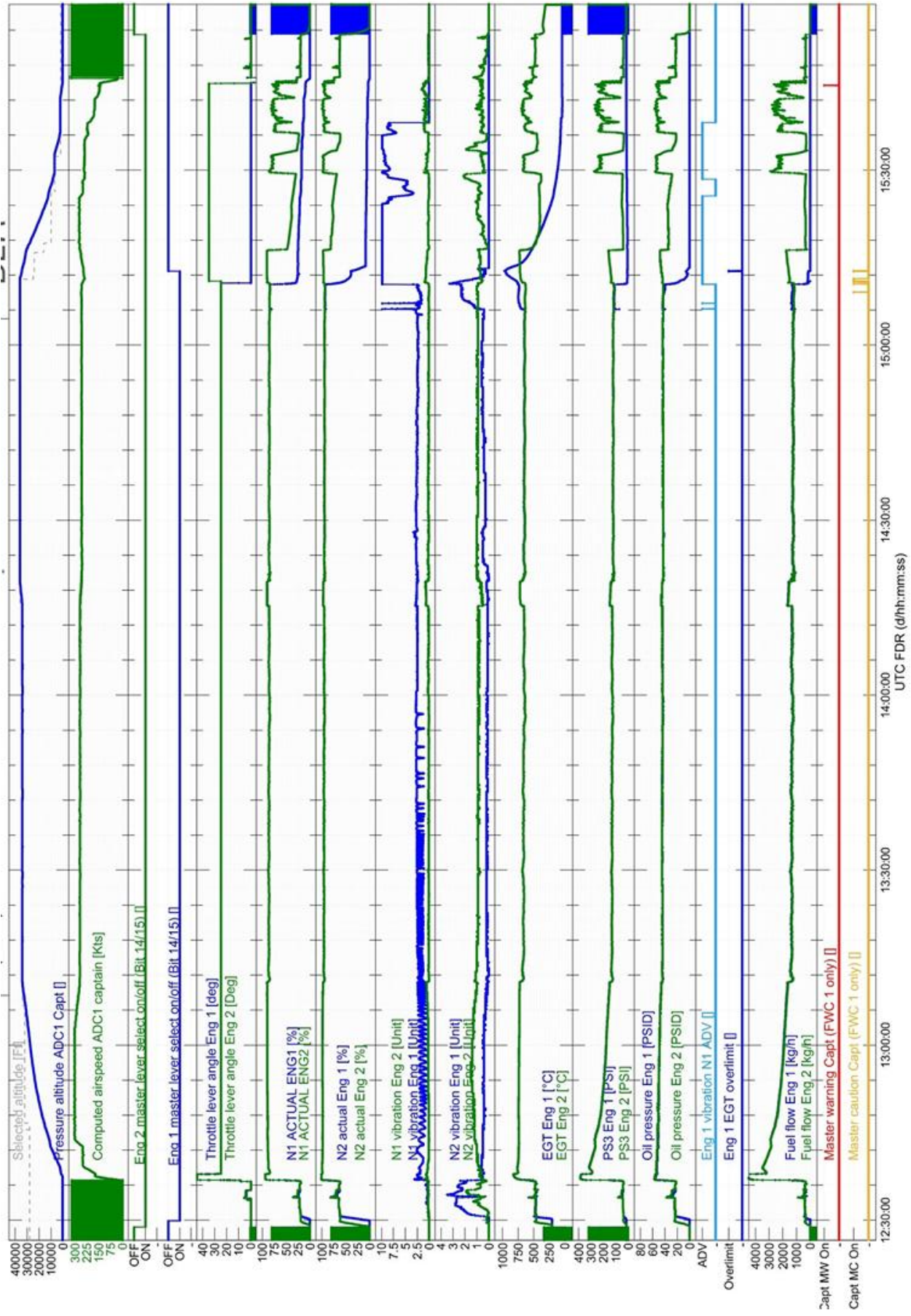
4. SAFETY RECOMMENDATIONS

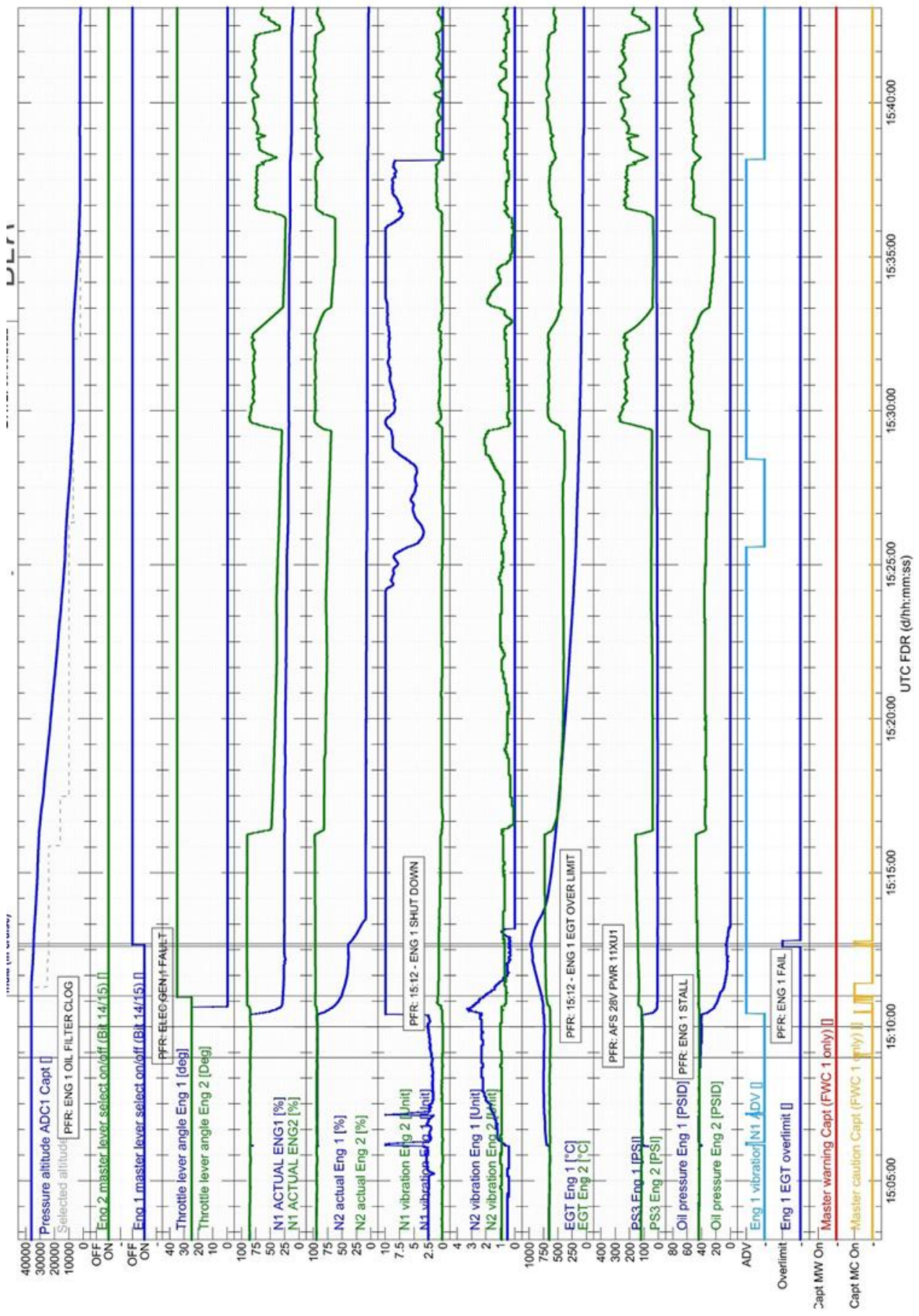
4.1 Safran and Airbus are working to improve the Troubleshooting Manual (TSM) to introduce an inspection of the CVT position following repeated tail pipe fire, so that any abnormality can be detected prior to failure of #4 bearing. The OEMs stated to have launched action and the target date for revision of TSM is November 2025. It is recommended that DGCA, India and GCAA, UAE monitor the actions being taken by SAFRAN and Airbus for timely implementation.

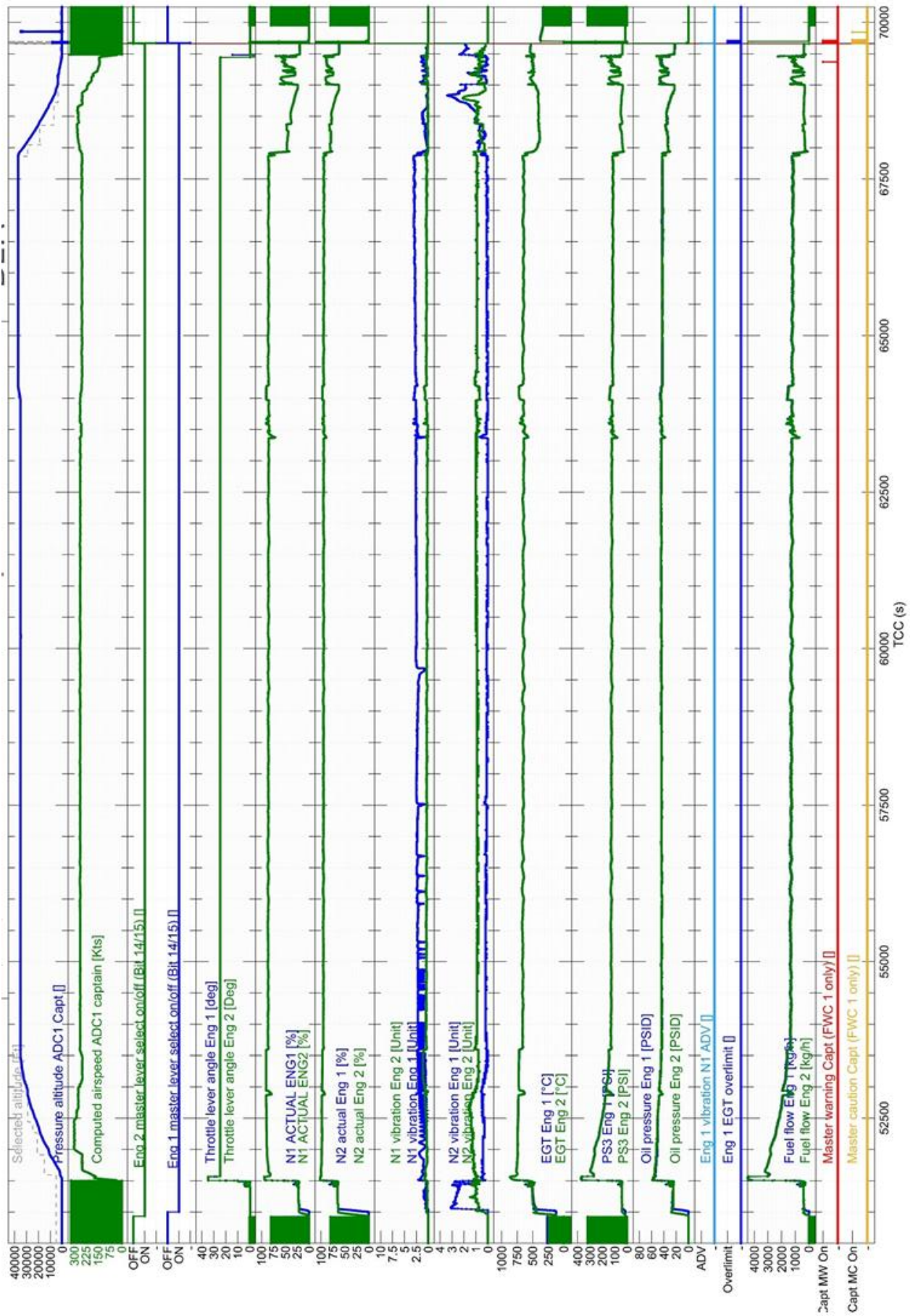
4.2 It is recommended that M/s Air Arabia may advise their crews to follow abnormal and emergency checklists in a timely manner.

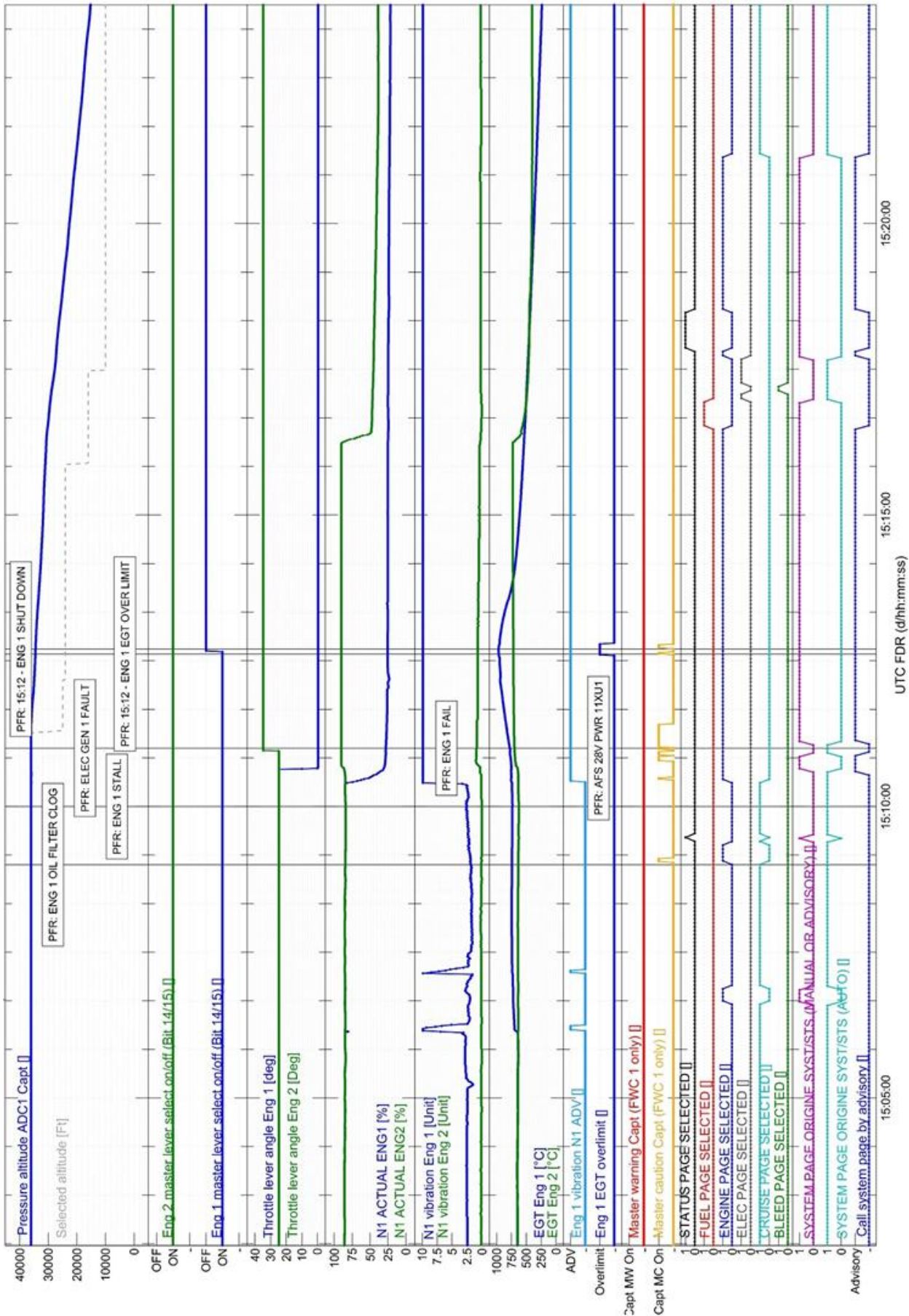
FDR Plots











CVR Transcript

Time	Origin	Transmission
08:47		Beeps (cockpit door)
		(discussing about weather radar, weather, lightening strikes) with third crew inside flight deck.
12:52	xx	Thank you guys, see you after a while (third crew leaves flight deck)
17:36	P2	Bangla control, Navras 062 , passing 295, xxxxxxxxx
	Bangla ctrl	Navras 062,contact kolkatta on 3225
	P2	ON 3225, Navras062, bye bye
18:20	P2	Kolkatta control, Namaskar, Navras 062 passing 298 to FL320, released by Bangla control
	CCU ctrl	Navras062, Kolkatta radar, identified.
	P2	Request FL032
	CCU ctrl	Stand by
21:06	CCU ctrl	Navras062, continue climb FL340
	P2	Continue climb FL340, Navras 062
49:27	radar	Navras 062, radar
	P2	Confirm calling , Navras 062
	radar	Navras 062, contact radar 125.9
49:37	P2	125.9, Navras062, bye bye
	P2	Radar, Navras 062, good evening, FL340
	radar	Navras 062, good evening, call at ASOPO
	P2	Call you ASOPO, Navras 062
1:18:07	P2	Radar, Navras 062, FL034, Position ASOPO
	Radar	Navras 062, Radar service terminated, contact Nagpur control 123.9
	P2	123.9, Navras 062, bye bye.
	P2	Nagpur control, Navras 062, good evening, FL340 position ASOPO
1:18:48	P2	Nagpur Control, Navras 062, level 340, good evening
	radar	Navras 772?
	P2	Navras 062
1:19:00	P1 & P2	Speak about approach and landing into various airports
1:22:35	radar	Navras 062, Nagpur control, identified, proceed direct to NINIM

	P2	Direct NINIM, Navras062
1:29:03	P1	Mumbai, Navras062, request climb level 360 due turbulence
	rdr	Navras 062, standby
1:29:25	radar	Navras062, radar
	P1	Go ahead
	Radar	Navras 062, climb to FL360
	P1	Climb to FL360, Navras 062
1:42:14	P1	How long this aircraft have this thing xxxxxxx
	P2	Yeah, boom , boom, boom,boom, boom...
	P1	2 to 2.5
	P2	Yeah
	P1	Xxxxx Engine Xxx 6 is it?
	P1	Xxxx for N1 & 2.3 for N2 xxxxxx Vibration.
1:43:08	P2	Xxxxx sleeping
	P1	What?
	P2	Its just like xxxxxx sleeping...
	P1	Yeah
1:44:27	Radar	Navras062, radar
	P2	Confirm xxxxxxx, Navras 062
	radar	Navras062, radar service terminated, contact Ahmedabad control 123.75
	P2	12375, Navras062, bye bye
	radar	Bye bye
1:45:00	P2	Ahmedabad control, Navras 062, good evening, FL360
	Radar	Navras 062, AMD radar, identified
1:48:22	radar	Navras062, radar, Proceed direct LAXOM, Report estimate RASKI
	P2	Proceed direct LAXOM, standby for estimate for RASKI, Navras 062
1:49:18	P2	Radar, Navras062, Estimate RASKI 1602
	radar	1602, roger
02:09:50	P1 & P2	Discuss about Ahmedabad
02:10:30	P1 & P2	Discuss about high temperature and places
02:20:34	P1	Jesus.... 9.9
	P2	9.9
	P1	Whistles
2:21:15		Beeps (door opening)

	xx	Hello , how are you guys
	P1	Did you hear that ?
	xx	Yeah
		VRV xxxxx vibration, this acceptable level? Popping up to 9.9....
	P2	Xxxxx checklist to reduce the flow, advising....
02:21:51	P1	Now its normal
	xx	Is it weather or.....
	P1	Yeah yeah, its just, engine some reason....
2:22:32	P1	Burning off xxxxxx
	P2	Xxxxxx coming
	P1	What?
	P2	Xxxxx Coming....
02:23:24		Chime – single(ECAM probably)
	P1	Engine 1 oil xxxxxx clogged
	P2	Engine 1 oil filter clogged, oil xxxxx 1 & 2, Engine 1 oil filter xxxxx
	P1	Yeah Yeah
	P1	Set course in the xxxx diversion?
	P2	It can be one aircraft happened in xxxx sometimes ago xxxxx.
02:24:20	radar	Navras062, radar service terminated, contact Mumbai oceanic 135.75, alternate monitor Mumbai radio 6661, secondary 8879.
	P2	13575, Mumbai HF, Navras062, bye bye.
	radar	Bye bye
02:24:45		Growling and spool down
02:24:49		Chime (ECAM)
	P2	Engine 1 stall
	P1	Engine 1 stall, engine actions please...
02:24:56		Chime (ECAM)
	P2	Thrust idle...
	P1	Thrust lever 1?
	P2	Affirm
	P1	Idle...
	P2	Xxxxxxxxxx
02:25:08		Chime (ECAM)
2:25:10	P2	If speed going down... and announce Mayday
02:25:14		Chimes – slow rate

02:25:16		Chime (ECAM)
	P1	Thrust xxx NGT xxx
02:25:20		Chime (ECAM)
02:25:22		Chime (ECAM)
	P2	Thrust xxxx , auto thrust is off, check heading, right
02:25:27		Chime (ECAM)
	P1	Right or left
	P2	Right xxxx window, start descend
2:25:38 01:23:36	P2	Ahmedabad control, Navras 062, Mayday Mayday Mayday , Engine failure, descending 360 to FL250, right heading 300
	P1	Seat belts ON
	radar	Navras 062 roger, turn right heading 300, roger Mayday
2:26:00	radar	Saudia804, radar, traffic info, traffic 12 o clock, 18 miles xxxx opposite direction airbus 320 descending passing FL360 to FL250
	Saudia	Copied, traffic we have him on TCAS Saudia 804
	radar	Saudia 804, turn right heading 150
	P2	Informed ATC, performance I will give you from performance page...
2:26:24		Beep
	P2	246, you can go down to 240
	P1	240?
	P2	Yeah and permission xxxxx
	P1	We can execute...
	P2	Engine 1 page, engine mode selected to ignition, ignore relight, engine master xxx off
2:26:52	P1	Engine xxxx off, yeah
	Radar	Navras062, radar
	P2	Navras062, standby
	P2	Engine master 1 off, Engine #1
2:27:05	P2	If damaged, engine #1 fire push button... push xxxx, red line ... so
	P1	Engine damaged? Do you think?
	P2	Xxxxx coming down xxxx No damage , fine
	P1	No damage
	P2	Ok, so engine is secured
	P1	Thank you

2:27:35	P2	Navras 062, Mayday passing FL340 and we request vectors for Ahmedabad and latest weather sir
	Radar	Navras 062, radar, roger Mayday turn left heading 050, vectoring for ... correction turn right heading 050 vectoring for ILS RWY23
2:27:58	P2	Roger, right heading 050... vectors ILS RWY23, Navras 062
	radar	Navras062, radar, roger Affirm , proceed direct Alpha Alpha Echo now
	P2	Proceed direct Alpha Alpha Echo, Navras 062.
2:28:27	P1	Thank you
2:28:30	radar	Navras062, radar, report total persons on board and endurance...
	P2	We have total on board 146, 140 passengers and 6 crew and stand by for endurance
2:29:03	P2	3 hours endurance?
	P2	Navras 062, endurance is 3 hrs.
	radar	Say Ahmedabad...
	P1	Ahmedabad, Navras062, endurance 3 hours
2:29:16	radar	Navras062, radar, roger copied...
	P2	Sir, request latest weather for Ahmedabad please
	radar	Navras 062, latest Ahmedabad weather.... Time 1500, wind 210 degree, 12 kts, visibility 4000 mts, No significant clouds, temperature 36, dew point 24, QNH 1002 trend no sig
	P2	Copied will be 4000 smoke, QNH 1002, Navras 062
	P2	Now xxxx, this place is VAAH-23
	P1	VAAH 23
	radar	Navras 062, radar
	P2	Go ahead
	radar	Confirm ready for further descend?
	P2	Affirm sir, ready for descend
	radar	Navras062, radar, roger, descend to FL160
2:30:15	P2	Descend FL160, Navras 062
	P1 & P2	Xxxxxxxx if you want auto thrust off, xxxxxxxxxxxx
	P2	Xxxxx I will set the box, I will read xxxxx ECAM first
	P2	Clear engine 1
	P1	Clear engine 1
2:30:48	P2	Ok, if you doubt fuel leak imbalance monitor
	P2	Ok TCAS mode select xxxxxx
2:31:12	P2	Electric GEN 1 faults ok

	P2	Clear Engine 1 shut off....
	P1	Engine 1
	P2	So now GEN 1
	P1	Clear GEN 1
	P2	Xxxx amber
	P1	Amber
	radar	Navras 062,radar, confirm left engine failure or right engine failure
	P2	Left engine failure , navras 062
	radar	Navras 062,radar,roger copied
2:31:45	P2	Electrical load Gen#1, start APU xxxxx
	P1	APU is ON
	radar	Navras 062, radar, descend to FL100
	P2	Descending FL100, Navras062
2:32:10	P1	Xxxxx
	P2	Advisory just came, ok land as soon as possible, xxxxx ignition, and xxxxx
	P1	FORDEC?
	P2	FORDEC, we will do after xxxx
	P1	After xxxx
	P2	Non normal checklist
	P1	Xxxx we can do xxxx
2:32:27	P1	Xxxxx Non normal checklist
2:32:39	P2	One pack only, if xxxx not applicable, xxxx along xxxx, dual engine xxxx, main galley generator 1 , clear status
	P1	Clear status
	P2	Engine is secured
	P1	Xxxx, I wonder why he xxxxxx
	P2	He understood what had happened, but we will turn on the time what we are doing, you just secure the cabin
	P1	Yeah
2:34:24	P2	And ready for FORDEC?
	P1	And the facts are.... We have engine failure of #1 engine and options are Ahmedabad, risks xxxxx single engine, decisions are to be made and we all are in. we don't have really lot of xxxxxxx
	P1 & p2	Xxxxxxxx
2:35:05	radar	Navras062, radar, report preference of approach

	P2	We request ILS Z, Navras 062
	radar	Navras 062, radar, roger, expect radar approach ILS Z Rwy 23
	P2	ILS Z radar vector, Navras 062
	P1	Xxxx execute ... C is checked
	P2	C is checked
	P2	Ah... course is set xxxx
2:35:55	P1 & p2	Xxxxx
	P2	Xxxx we will ask radar vectors and I will give you xxxx
2:36:53	P1	Xxxx landing performance
	P2	Yeah
2:37:45	P2	210 alpha
	P1	Temperature
	P2	36
	P1	QNH
	P2	1002
	P1	Dry, xxxx , off
	P2	Sixty eight four
	P1	Sixty eight four?
	P2	Yeah
2:38:24	radar	Navras062,radar, fly heading 085, vectoring for ILS Z Approach Runway 23
	P2	Confirm heading 085, Navras062
	radar	Navras 062, affirm, fly heading 085, vectoring for ILS Z approach runway 23
	P2	Copied 085, ILS Z rwy 23, Navras062
	P2	Xxxxxxx
	P1	Checked xxxxx approach gradient
	P2	2.5
2:38:57		Long tone
2:39:45	P2	Xxxxx
	P1	Flaps full
	P2	Xxxx you have to do flaps full
	P2	Landing distance xxxxxxxxx
2:40:01	P2	Your control huh
	P1	My controls

2:39:58	radar	Navras062,radar, contact approach radar 119.8
	P2	119.8, navras 062, bye bye
2:40:05	radar	Bye bye
2:40:34	P2	Approach, navras062, Mayday passing 118 descending FL100, engine failure
	Aprch	Navras062, mayday, descend to FL70
	P2	Descending FL070, Navras062
	P2	70 checked, yes you can talk to the passengers if you wanna call and brief them
2:41:29		Beeps (flight deck door)
	P1	Nature is engine failure, intensions are to go to Ahmedabad, time remaining is 10... 15 minutes, you all gonna wait, we are not anticipating any problem and we will let you know. At this stage nothing special xxxxx
	xx	You need to start announcement xxxxx
	P1	Yeah
	xx	I will do cabin check and secure it and report again xxxx thank you very much sir.
	P1	Thanks
2:42:28	P1	Ladies and gentleman, from the flight deck Captain xxxxx, speaking, as you may xxxx, we have an engine failure, tonight turning to Ahmedabad, crew will give you briefing shortly. Time to Ahmedabad 15 minutes. I am anticipating normal landing and taxi into parking stand. We apologize for this. We will give you more information once we are on ground
2:42:58	P2	Xxxx
	P2	One one zero descending xxxxx
2:43:00	P2	Ok, 10000 checks please, 110.3, 225 is the final course etc
	P1	Xxxx page down?
	P2	Bleed I did for over hear landing checklist, we are below 10000, so I just did that one
	P1	That's ok
	P2	And rest is there, I will give you the
	P1	Ok
	P2	Transition is 4000, we can do the briefing now?
	P1	Yeah
	P2	Ok, so we have MORA, MOCA, MSA, is 2000, stars is ...-there is no star on radar, type of approach – ILS Z 23, checked. Minimum is 430- baro 430 in box. Go around trajectory, I will give you, is course 225, reaching 2000, direct AAE, hold right turn over Alpha Alpha

		Echo. In case of go around, if you wanna make it simple, I will just ask for runway heading and vectors and we will come back
	P1	Ok
1:44:18	P1	Xxxx rapid decelerated, because engine failure, what type of xxxx with it, landing flaps setting is CONFIG FULL. Stop margin is discussed and 1500 I think...
	P2	79C3, you made it with reverser or No?
	P1	Yeah I did
	P2	Auto brake – low, ok you made medium huh?
	P1	Medium, because it is engine failure.. so only medium
	P1	Ok, that what I always remember, if you have failure you have medium brakes
	P2	Medium, I will make reverse idle
	P1	Yeah 15 hundred 42
	P2	Ok
	P1	Unless the other checklist xxxx so use the full reverse xxxx
	P2	Go to the xxxx, yeah yeah that one, runway 23, press on the little thing on the right
	P1	This one?
	P2	Yeah, now you can see, runway 23, after landing we will be to the right vacating
	P1	Because it is the other way
	P2	Exactly
	P1	Any hot spots? There is a hotspot there
2:45:58	radar	Navras062, radar, turn right heading 090
	P2	Right heading 090,navras062
	P1	Special operations... obviously we gonna leave that shortly, non standard operations... yeah well... there is few things... threats – failure of the engine... unusual airport to me. Everything need to be sorted outwards with it.
2:46:26	P1	Lets get back checklist done
	P2	Checked approach checklist... will be after
	P1	Yeah yeah the other one.. the other way
	P2	Origin xxxx
	P1	Thanks man
	P2	Xxxxx once again
2:46:41	radar	Navras062,radar, descend 2000ft, transition level 55, QNH 1003

	P2	Descending 2000ft, QNH 1003, transition 55, Navras 062
	P1	5000 left, 2000 blue
	P2	Checked
2:46:54	P2	All right landing checklist, it says use full configuration full for landing unless specified for abnormal procedure or limited by landing performance.
	P1	Yeah
	P2	Visit landing performance is ok, landing distance procedure apply... applied, for approach PACK 1 off, or supplied by APU
	P1	Ok
	P2	So supplied by APU now, we go to the bleed page, APU is there and it is already auto
	P1	Yeah
	P2	And we have... if landing configuration other than full... use config 1+F for go around and not our case. Speed at runway threshold VLS. So once over Threshold... I m gonna decrease speed to Vls. Minimise Vfs at touchdown, xxxx after nose touchdown apply brakes as much xxx and when landing completed brake fans ON. Landing runway is 3500 mts long and 45 mtrs wide. So its fine.... Happy?
	P1	Yeah
	P2	So runway 23 is there... you gonna come like that, I can give you direct from now further sequencing from...
	P1	Fix may be...
2:48:35	P2	045, happy
2:48:43	P2	Pull heading please
2:49:02	P2	Ok FORDEC is done, transition 1003
	P1	1003
	P2	Cross check passing 3800 now
	P1	Checked
2:49:14	P2	Approach checklist?
	P1	Yes please
	P2	Baro ref
	P1	1003
	P2	Seat belts
	P1	ON
	P2	Minimum
	P1	430

	P2	Auto Brake
	P1	Medium
2:49:32	P2	Approach checklist completed
	P1	Thank you
2:49:41	P2	You always do medium.... Engine failure? because today we are overweight.... Might get tyre burst after this huh
	P1	Ok... just be alert
	P2	So just go low and then if you are comfortable on centreline just remove it long runway huh... keep it rolling
	P1	Yeah
	P2	1000 to xxxx
	P1	Checked
2:50:00	P2	Xxxx push for you
	P1	I hope checklist... that might manual brake
	P2	It says increase flare height, apply brakes as necessary
	P1	As necessary ok
	P2	So its upto you.. know
	P2	So two thousand we are descending two thousand intercepting altitude as well
2:50:40	P1	Speed xxxx
	P2	Checked
	P2	You will be ready for approach on reaching...
	P1	Yeah
	P2	Navras062, maintaining 2000 heading 090 and we will be ready on approach
	Radar	Roger, standby
	P2	Stand by
2:50:57	radar	Navras062, 25 miles from touchdown
	P2	Affirm, just asking you to guidance for the... we are ready now, so whenever you think we are good you can guide us for final.
	radar	Roger
	P1	Oh... might just xxxx I have to have this.....
	radar	Navras062, radar, visibility 4000 mts, confirm visual approach acceptable
	P2	Negative, we will go for the ILS Navras 062
	radar	Roger

2:51:56	P2	So heavy, early stabilize, altitude xxxx 2000 ft, so we will delay landing gear until we establish on glide otherwise it gonna create too much drag
	P1	Yeah
2:52:16	P1	Xxxx flaps xxxx
	P2	Speed checked
	radar	Navras062,radar, turn right heading 100
	P2	Right heading 100, navras062
2:53:02	P2	Captain keep airspeed
	P1	Yeah , I am gonna xxxx
	P2	Ok
	P1	Flaps 2
	P2	Speed checked
	P1	Xxxx I d rather fly that margin xxxx because it is heavy
	P2	Ok, you don't do this under xxxx
	P1	That's right
	P2	India alpha hotel delta identified
	P1	Checked
2:53:38	radar	Navras062, radar, turn right heading 125, position 15 miles from touch down
	P2	Right heading 125, Navras 062
2:54:35	radar	Navras 062, radar, turn right heading 195 to intercept localizer rwy 23
	P2	Right heading 195 to intercept localizer rwy 23, navras062
	P1	Xxxx cleared
	P2	Checked
2:55:16	P2	Ok, so, VLS at threshold
	P1	Ok
	P2	Increase flare height, then after landing reverser used
	P1	Ok
	P1	Loc star xxxxx
	P2	Checked... established localizer rwy 23, Navras 062
	radar	Navras 062, 9 miles from touchdown, contact tower 119.6
	P1	Are we cleared
	P2	Confirm cleared for ILS, Navras062

	radar	Navras 062 Affirm, cleared for ILS approach Runway 23, contact Tower 119.6
	P2	1196, Navras062, good day
	P1	Cat 3 xxxx single auto pilot 1+2
	P2	Checked
	P1	Have visual
2:55:51	P2	Ahmedabad tower, Navras 062, Mayday established final runway 23
	twr	Navras062, Ahmedabad Tower, Rwy 23, clear to land, wind 200 degree, 12 kts
	P2	Copied Rwy 23, cleared to land, Navras 062
	P2	You want me to request for fire truck or not?
	P1	They should have, because this mayday
	P2	Yeah, we will be stopping on the runway, I will tell him that?
	P1	Yeah
2:56:28	P2	Navras062, we will be stopping on the runway after landing
	Twr	Copied
2:56:36	P1	Speed managed
	P2	Speed managed checked
	P1	Xxxx gear out
	P2	2000, gear coming down
	P1	Xxxx
	P2	Checked
	P1	Flaps 3
	P2	Speed checked, flaps 3
	P1	Flaps full
	P2	Speed checked, flaps full
	P1	Landing check list
	P2	Landing checklist, ECAM memo
	P1	Landing xxxxx blue
	P2	Landing checklist complete
2:57:19	P2	Confirm xxxx, Navras062
	twr	Navras062, Ahmedabad Tower, Affirm runway 23, clear to land, wind 200 degree, 12 kts
	P2	Copied Navras062, clear to land Rwy 23
2:57:54		One thousand (aural)

	P1	Checked
	P2	Checked
2:58:47	P1	Xxxx
	P2	Checked
	P1	Auto pilot coming out
2:58:52		Auto pilot disconnect (aural)
	P2	Checked
2:58:55		Minimum (aural)
	P1	Continue
	P2	Checked
2:59:12		Fifty (aural)
	P2	Flare, flare, flare
2:59:14		Twenty (aural)
2:59:15		Retard(aural)
2:59:19		Five (aural)
2:59:20		TOUCHDOWN
	P2	Spoilers, reverser, one reverser is green, decel
2:59:38	P2	70 kts
	P1	Checked
2:59:46	P2	Nicely done... beautiful
	P1	Thank you
	P2	I will just give you ground chart, lets see where is exit
	P1	Blue is coming up
	P2	Blue is charlie
	P1	Yeah, lets get closer and we can vacate charlie
3:00:15	P2	Navras 062, vacating charlie
	twr	Navras 062, approved
	P2	Ok, brake fans ON
	P1	Yeah, thanks
3:00:36	P2	Clear right
	P2	I will get the stand
	P2	Navras 062, you can give us any stand
	twr	Navras062, taxi via charlie golf stand 42, follow follow me jeep
	P2	Ok, taxi via charlie golf stand 42, follow follow me jeep, Navras062
	P2	So golf will be here

	P1	This is golf yeah? To the right
	P2	Yeah this is golf, just slow down, follow me will come
	P1	They are coming? that one there
	P2	I think so, that's a jeep, yeah that one there
3:01:40	twr	Navras062, Ahmedabad Tower, taxi via charlie, golf, stand 42, follow follow me jeep
	P2	Copied, charlie-golf-stand 42, follow follow me jeep, jeep in sight, navras062
3:02:00	Follow me	Tower, xxxx coming for follow me service for Air Arabia to stand 42
	twr	Copied
3:02:27	P1	After landing checklist please
	P2	After landing, radar and xxxx wind shear xxxx
	P1	Off
	P2	After landing check list is completed and I just left this on ignition huh?
	P1	Yeah sure
	P2	Wheel temperature ok now, fine, will go tell him disregard mayday
	P1	Yeah
	P2	Tower, Navras 062,disregard and cancel mayday
	twr	Copied
	P2	Clear right
	P1	Clear, where is the stand we are cleared to?
	P2	It will be around this, you need to make right turn
03:03:52	twr	Follow me jeep1
	P2	Forty, forty one
I	P2	Tower, Navras 062, confirm no marshaller
	twr	Standby, marshaller is reaching standby
	P2	Ok, Navras062
3:06:13	P2	We will call them, they should know we have diverted
3:07:12	twr	Navras062,tower,follow marshaller
	P2	Following marshaller, Navras 062, thank you so much for your help
	twr	Welcome sir
3:08:10	P2	Ok parking
	P2	Parking brakes or chokes
	P1	ON
	P2	Engines

	P1	Off
	P2	Wing lights
	P1	Off
	P2	Fuel pumps
	P1	Off
	P2	Parking checklist complete
	P1	Thank you
	P2	Engine is off like 30 minutes... (discuss about alternate aircraft and contacting company)
		Recording stops

I. ENGINE TAILPIPE FIRE CHECKLIST

[QRH] ENGINE TAILPIPE FIRE	
Ident.: PRO-ABN-ENG-00017781.0001001 / 17 MAR 17	
Applicable to: ALL	
Internal engine fire may be encountered during engine start or engine shutdown. Internal engine fire may be seen by the ground crew, or the EGT may fail to decrease after the ENG MASTER lever is set to OFF.	
CAUTION	External fire agents can cause severe corrosive damage. Consider the use of external fire agents only if the following procedure does not stop engine tailpipe fire.
ENG MASTER (affected engine) OFF	
<i>Note: Do not press the engine fire pushbutton, since this would cut off the FADEC power supply, which would prevent motoring sequence.</i>	
ENG MAN START pb (affected engine) OFF	
ESTABLISH AIR BLEED PRESS	
<i>Select the APU, or opposite BLEED, to motor the engine.</i>	
<i>If APU BLEED is not available, and the opposite engine is shut down, connect external pneumatic power (if readily available).</i>	
BEACON ON	
ENG MODE sel..... CRANK	
ENG MAN START pb (affected engine)..... ON	
<i>For aircraft equipped with IAE or PW6000 engines, the start valve automatically reopens, when N2 is below 10 %.</i>	
<i>For aircraft equipped with CFM 56-5A/5B engines, the start valve automatically reopens, when N2 is below 20 %</i>	
<i>For aircraft equipped with CFM LEAP-1A engines, the start valve automatically reopens, when N2 is below approximately 60 %</i>	
● When fire stopped:	
ENG MAN START pb (affected engine)..... OFF	
ENG MODE sel..... NORM	
Maintenance action is due.	

II. HIGH ENGINE VIBRATION CHECKLIST

[QRH] HIGH ENGINE VIBRATION	
Ident.: PRO-ABN-ENG-00012294.0006001 / 19 SEP 17	
Applicable to: MSN 03246-08343, 08748-08798, 08942	
The VIB advisory on ECAM (N1 ≥ 6 units, N2 ≥ 4.3 units) is mainly a guideline for the flight crew to monitor engine parameters more closely. The ECAM vibration advisory alone does not require engine shut down.	
<i>Note: 1. High engine vibration may be accompanied by cockpit and cabin smoke and/or the smell of burning. This may be due only to compressor blade tip contact with associated abradable seals.</i>	
<i>2. High N1 vibration are generally accompanied by perceivable airframe vibrations. High N2 vibration can occur without perceivable airframe vibrations.</i>	
ENG PARAMETERS CHECK	
<i>Check engine parameters and especially EGT; crosscheck with other engine. Report in maintenance log.</i>	
■ If icing suspected:	
An increase of engine vibration in icing conditions with or without engine anti-ice may be due to fan blades and/or spinner icing. Icing may be suspected if N1 vibration occurs without other engine parameters variation.	
A/THR OFF	
THRUST (one engine at a time)..... IDLE THEN INCREASE N1 > 80 %	
<i>Reduce thrust to idle if flight conditions permit.</i>	
<i>If ENG ANTI ICE is off, switch it ON at idle fan speed, one engine after the other with approximately 30 s interval.</i>	
<i>To shed ice, it may be necessary to perform several thrust variations between idle and a thrust compatible with the flight phase. For efficient ice shedding, thrust should be increased to at least 80% N1 if flight conditions permit.</i>	
<i>After each thrust variation, vibrations should decrease, indicating the progress of the ice shedding.</i>	
<i>When the ice is shed, vibrations should return to normal and the flight crew can resume normal engine operation.</i>	
■ If icing not suspected:	
● If above vibration advisory and flight conditions permit:	
THRUST (affected engine)..... REDUCE BELOW ADVISORY THRESHOLD	
● After landing, if vibrations continue : SHUT DOWN ENGINE WHEN POSSIBLE	

III. ENGINE STALL CHECKLIST

[QRH] ENG 1(2) STALL

Ident.: PRO-ABN-ENG-00015730.0001001 / 05 MAR 19
 Applicable to: MSN 03246-08343, 08748-08798, 08942

This crew must apply this procedure when instructed by ECAM, or if they detect an engine stall before FADEC:

- **On Ground:**
 - THR LEVER (affected engine).....IDLE
 - ENG MASTER (affected engine).....OFF
- **In Flight:**
 - THR LEVER (affected engine).....IDLE
 - ENG PARAMETERS (affected engine).....CHECK
 - **If abnormal ENG parameters:**
 - ENG MASTER (AFFECTED ENGINE)..... OFF
 - ENG 1(2) SHUT DOWN
 - Apply the ENG SHUT DOWN ECAM procedure (Refer to PRO-ABN-ENG ENG 1(2) SHUT DOWN). Engine restart at crew discretion.
 - **If normal ENG parameters:**
 - ENG ANTI ICE (affected engine).....ON
 - Operation of ENG and WING ANTI ICE will increase the stall margin but EGT increases accordingly.
 - THR LEVER (affected engine).....SLOWLY MOVE FORWARD
 - **If stall recurs:**
 - THR LEVER (affected engine)..... MOVE BACKWARD
 - Reduce thrust and operate below the thrust threshold where stall recurs.
 - **If stall does not recur:**
 - CONTINUE NORMAL ENGINE OPERATION

IV. ENGINE FAIL ANNUNCIATION CONDITION & CHECKLIST

ENG 1(2) FAIL

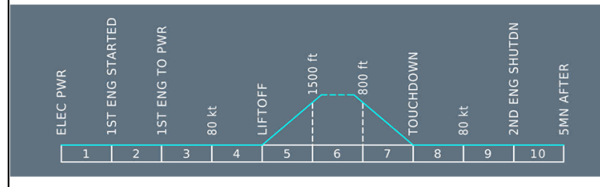
Applicable to: MSN 03246-08343, 08748-08798, 08942
 Ident.: PRO-ABN-ENG-BJ-00017982.0002001 / 06 JUN 16

ANNUNCIATIONS

Triggering Conditions:

- ⓘ This alert triggers when the engine core speed is below idle, with the ENG MASTER lever set to ON, and ENG FIRE pb not pushed.

Flight Phase Inhibition:



ENG 1(2) FAIL (Cont'd)

Ident.: PRO-ABN-ENG-BJ-00017667.0003001 / 04 JUN 19

- ⓘ An engine flame-out may be recognized by a rapid decrease in EGT, N2, FF, followed by decrease in N1 for CFM engines, or EPR for IAE engines.

The flight crew can suspect an engine damage if the flight crew observes two or more of the following symptoms:

- Rapid increase of EGT above the red line
- Important mismatch of the rotor speeds, or absence of rotation
- Significant increase of aircraft vibrations and/or buffeting
- Hydraulic system loss
- Repeated or uncontrollable engine stalls

ⓘ **LAND ASAP**

- **Before takeoff or after landing:**
 - THR LEVER (AFFECTED ENGINE)..... IDLE
 - ENG MASTER (AFFECTED ENGINE)..... OFF

- **IF DAMAGE:**
 - ENG FIRE P/B (AFFECTED ENGINE)..... PUSH
 - AGENT 1..... DISCH

■ **IF NO DAMAGE:**

- ⓘ For CFM engines, if conditions permit, do not restart the engine. A new engine start would erase FADEC troubleshooting data.
- ⓘ ENG (AFFECTED) RELIGHT..... CONSIDER
- ⓘ If no damage, a new start sequence may be initiated.

ASSOCIATED PROCEDURES

ENG 1(2) SHUT DOWN

Apply the ENG SHUT DOWN procedure (Refer to PRO-ABN-ENG ENG 1(2) SHUT DOWN), if damage or if engine relight is unsuccessful.

- ⓘ ■ **In flight:**
 - ENG MODE SEL..... IGN
 - ⓘ Selection of continuous ignition confirms the immediate relight attempt made by the FADEC.
 - ⓘ THR LEVER (AFFECTED ENGINE)..... IDLE

ENG 1(2) FAIL (Cont'd)

Note: In case of GPWS (EGPWS \llcorner) alerts, reduce speed with care below VLS with flaps extended (at light weights VMCA may be reached before α Max) when applying the GPWS (EGPWS \llcorner) procedure.

IF NO ENG RELIGHT AFTER 30 S:
The 30 s countdown starts as soon as the **ENG 1(2) FAIL** alert is triggered.

ENG MASTER (AFFECTED ENGINE)..... OFF

IF DAMAGE:
ENG FIRE P/B (AFFECTED ENGINE)..... PUSH
AGENT 1 (AFTER 10 SECONDS IN FLIGHT)..... DISCH

ASSOCIATED PROCEDURES

ENG 1(2) SHUT DOWN

Apply the **ENG SHUT DOWN** procedure (Refer to PRO-ABN-ENG ENG 1(2) SHUT DOWN), if damage or if engine relight is unsuccessful.
If high vibration occurs and continues after engine shutdown, reduce airspeed and descent to a safe altitude.
Attempt to determine and use a practical airspeed and altitude for minimum vibrations.

IF NO DAMAGE:
ENG (AFFECTED) RELIGHT..... CONSIDER
Apply **ENG RELIGHT (in flight)** procedure (Refer to PRO-ABN-ENG [QRH] ENG RELIGHT IN FLIGHT).

V. EGT OVER LIMIT ANNUNCIATION CONDITION AND CHECKLIST

ENG 1(2) N1/N2/EGT OVER LIMIT

Applicable to: MSN 03246-08343, 08748-08798, 08942
Ident.: PRO-ABN-ENG-CD-00018006.0002001 / 21 MAR 16

ANNUNCIATIONS

Triggering Conditions:
This alert triggers when:
- N1 is above 104 %, or
- N2 is above 105 %, or
- EGT is above 725 °C during start, or above 950 °C when the thrust levers are at TOGA or FLX/MCT position, or 915 °C in the other cases.

Flight Phase Inhibition:

ENG 1(2) N1/N2/EGT OVER LIMIT (Cont'd)

Ident.: PRO-ABN-ENG-CD-00012079.0013001 / 21 MAR 17

Max pointer indication:
EGT between 915 °C and 950 °C (except during takeoff, alpha floor activation, or reverse selected), or EGT between 950 °C and 970 °C, or
N1 between 104.0 % and 105.8 % or
N2 between 105.0 % and 105.8 %
THR LEVER (OF AFFECTED ENGINE)..... BELOW LIMIT
Normal operation may be resumed and maintained until next landing. Report in maintenance log.

Max pointer indication:
EGT above 970 °C or
N1 above 105.8 % or
N2 above 105.8 %
THR LEVER (OF AFFECTED ENGINE)..... IDLE
ENG MASTER (OF AFFECTED ENGINE)..... OFF
If conditions do not permit engine shutdown land ASAP using the minimum thrust required to sustain safe flight.

ASSOCIATED PROCEDURES

ENG 1(2) SHUT DOWN
Apply the **ENG SHUT DOWN** procedure (Refer to PRO-ABN-ENG ENG 1(2) SHUT DOWN).

VI.ALERT TRIGGERING CONDITIONS

ENG 1(2) OIL FILTER CLOG

Applicable to: MSN 03246-06737, 07096-08343

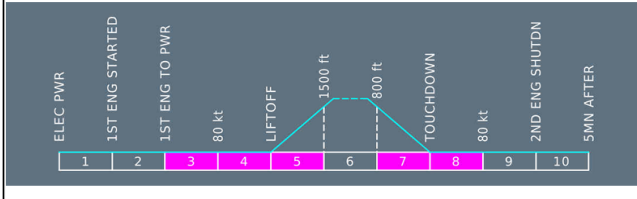
Ident.: PRO-ABN-ENG-CF-00017964.0002001 / 21 MAR 16

ANNUNCIATIONS

Triggering Conditions:

- L2** This alert triggers when the oil filter is clogged.

Flight Phase Inhibition:



Ident.: PRO-ABN-ENG-CF-00012078.0007001 / 30 MAR 18

OIL PARAMETERS..... MONITOR

- L2** Maintenance action is due, except if the caution is temporarily displayed during cold engine start with engine oil temperature lower than 40 °C.

ENG 1(2) OIL HI TEMP

Applicable to: MSN 03246-08343, 08748-08798, 08942

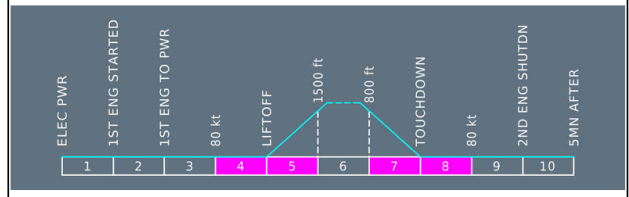
Ident.: PRO-ABN-ENG-CH-00017969.0001001 / 21 MAR 16

ANNUNCIATIONS

Triggering Conditions:

- L2** This alert triggers when the oil temperature is:
 - Between 140 °C and 155 °C for more than 15 min, or
 - Above 155 °C.

Flight Phase Inhibition:



Ident.: PRO-ABN-ENG-CH-00017822.0002001 / 26 NOV 19

THR LEVER (AFFECTED ENGINE)..... IDLE
 ENG MASTER (AFFECTED ENGINE)..... OFF

- L2** Operation above the maximum temperature requires engine shutdown.

L12

ENG 1(2) OIL LO PR

Applicable to: MSN 03246-08343, 08748-08798, 08942

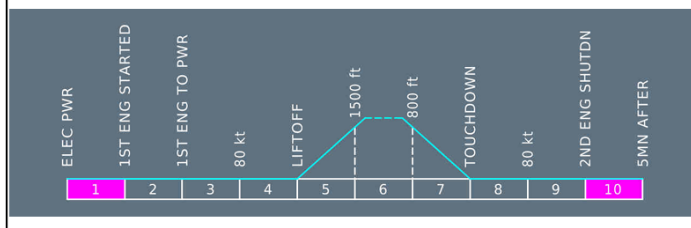
Ident.: PRO-ABN-ENG-CI-00018002.0006001 / 21 MAR 16

ANNUNCIATIONS

Triggering Conditions:

- L2** This alert triggers when oil pressure is below 13 PSI.

Flight Phase Inhibition:



Ident.: PRO-ABN-ENG-CI-00018796.0001001 / 26 NOV 19

- L2** Check oil pressure indication on ENG SD page.

- L1** ● IF OIL PR < 13 PSI

THR LEVER (OF AFFECTED ENGINE)..... IDLE
 ENG MASTER (OF AFFECTED ENGINE)..... OFF

L12

ASSOCIATED PROCEDURES

ENG 1(2) SHUT DOWN

Apply **ENG 1(2) SHUT DOWN** procedure (Refer to PRO-ABN-ENG ENG 1(2) SHUT DOWN).

Note: If oil pressure is indicated red on ENG SD page without the **ENG 1(2) OIL LO PR** alert, it can be assumed that the oil pressure transducer is faulty. Flight crew may continue engine operation while monitoring other engine parameters.

VII.ENGINE STALL ANNUNCIATION TRIGGERING CONDITIONS AND CREW ACTION

ENG 1(2) STALL	
Applicable to: ALL	
Ident.: PRO-ABN-ENG-Z-00017876.0001001 / 21 MAR 16	
ANNUNCIATIONS	
Triggering Conditions:	
L2	This alert triggers when an engine stall is detected.
Flight Phase Inhibition:	

ENG 1(2) STALL (Cont'd)	
Ident.: PRO-ABN-ENG-Z-00017749.0005001 / 17 MAR 17	
<p>This alert is triggered when FADEC detects an engine stall. Indications of an engine stall include varying degrees of abnormal engine noises/bangs, accompanied by flame from the engine exhaust (and possibly from the engine inlet in severe case), fluctuating performance parameters, vibration, sluggish or no thrust lever response, high EGT and/or a rapid EGT rise when thrust lever is advanced. Engine stalls must be reported for maintenance action.</p>	
<p>■ On Ground:</p> <p>THR LEVER (AFFECTED ENGINE)..... IDLE ENG MASTER (AFFECTED ENGINE)..... OFF</p>	
<p>■ In Flight:</p> <p>THR LEVER (AFFECTED ENGINE)..... IDLE ENG PARAMETERS (AFFECTED ENGINE)..... CHECK ENG 1(2) STALL PROC..... APPLY</p>	
Ident.: PRO-ABN-ENG-Z-00017748.0001001 / 21 MAR 16	
STATUS	
CONSIDER ENG 1(2) RELIGHT <div style="border-left: 1px solid black; width: 10px; height: 20px; margin: 0 auto;"></div>	