



सत्यमेव जयते

**GOVERNMENT OF INDIA
CIVIL AVIATION DEPARTMENT**



**Final Investigation Report of Engine In-Flight Shutdown Incident to M/s. AIX
Connect Pvt Ltd Aircraft VT-VTZ (I5-1563) After Takeoff from Kolkata on
08.01.2024.**

**O/o Director General of Civil Aviation
Air Safety Directorate,
New Delhi– 110003**

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FOREWORD

This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. The investigation has been carried out as per DGCA order issued under Rule 13(1) of the Aircraft (Investigation of Accidents and Incidents), Rules 2017; and format of the report is as per Annex 13 to the convention on International Civil Aviation Organization (ICAO).

The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this incident which may help to prevent occurrence of such incidents in future.

ABBREVIATIONS

Abbreviation	Expanded form
AD	Airworthiness Directive
AGB	Accessory Gearbox
AIDS	Aircraft Integrated Data System
ALF	Aft Looking Forward
AMM	Aircraft Maintenance Manual
AP	Auto Flight
ARC	Airworthiness Review Certificate
ATPL	Airline Transport Pilot License
BA	Breath Analysis
BITE	Built In Test Equipment
CNR	Customer Notification Report
CPL	Commercial Pilot License
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
ECAM	Electronic Centralized Aircraft Monitoring
EDP	Engine Driven Pump
EMCD	Electro Magnetic Chip Detector
ESN	Engine Serial Number
EVMU	Engine Vibration Monitoring Unit
EWIS	Electrical Wiring Interconnection System
FAA	Federal Aviation Administration
FADEC	Full Authority Digital Engine Control
FC	Flight Cycles
FCN	Fault Code Number
FH	Flight Hours
FIN	Functional Item Number

IGB	Inlet Gear Box
ILS	Instrument Landing System
LH	Left Hand
LPT	Low Pressure Turbine
MCD	Magnetic Chip Detector
MEL	Minimum Equipment List
METAR	Meteorological Aerodrome Report
MR1	Maintenance Records 1
OEM	Original Equipment Manufacturer
PFR	Post Flight Report
QRH	Quick Reference Handbook
RDS	Radial Drive Shaft
RH	Right Hand
SB	Service Bulletin
TAF	Terminal Aerodrome Forecast
TFU	Technical Follow-up
TGB	Transfer Gearbox
TRF	Turbine Rear Frame
TSD	Troubleshooting Data
TSM	Troubleshooting Manual
UTC	Coordinated Universal Time
VBV	Variable Bleed Valve
VSB	Vendor Service Bulletin
WQAR	Wireless Quick Access Recorder

**Final Investigation Report of Engine In-Flight Shutdown Incident to M/s. AIX Connect Pvt
Ltd Aircraft VT-VTZ (I5-1563) After Takeoff from Kolkata on 08.01.2024**

- | | |
|------------------------------|--|
| a) Aircraft Details: | |
| Type | :Airbus 320-214 |
| Nationality | : Indian |
| Registration | : VT-VTZ |
| Call Sign | : I5-1563 |
| b) Operator | :M/s AIX Connect Pvt Ltd. |
| c) Pilot-in-Command | :ATPL Holder |
| Extent of injuries | : Nil |
| d) First Officer | :CPL Holder |
| Extent of injuries | : Nil |
| e) Crew on Board | :06 |
| Extent of injuries | : NIL |
| f) Passengers on Board | :176 |
| Extent of injuries | : NIL |
| g) Sector | :Kolkata to Bhubaneswar |
| h) Date & time of incident | :08 th January 2024, 1210 UTC (approx.) |
| i) Last Point of Departure | :Kolkata |
| j) Place of incident | :Kolkata |
| k) Point of Intended Landing | :Bhubaneswar |
| l) Type of operation | :Scheduled Domestic Operation |
| m) Phase of operation | :Climb |
| n) Type of incident | :SCF-PP |

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

SYNOPSIS :

On 08th January 2024, M/s AIX Connect Pvt. Ltd., A320-214 Aircraft registration VT-VTZ, while operating scheduled flight I5-1563 from Kolkata (VECC) to Bhubaneswar (VEBS) was involved in an incident of Engine In-flight shutdown during climb at about 18000 ft and 30 Nm outbound Kolkata.

The flight crew heard a boom sound followed by N1 of engine#1 dropping and after 2-3 sec autopilot went off followed by an un-commanded engine#1 shutdown. Thereafter the flight crew tried to relight the engine#1 which went unsuccessfully and declared PAN-PAN thereafter. I5-1563 requested for priority landing from ATC and landed safely in Kolkata airport. No fire or injury to any of the occupants on board the aircraft was reported.

The DGCA has instituted investigation into the incident to investigate the cause of the incident by appointing Investigator-in-charge and Member vide order no DGCA-15019(1)/1/2024-DAS dated 06.02.2024 under Rule 13(1) of Aircraft (Investigation of Accident and Incidents) Rules 2017.

The investigation reveals that, the probable cause of the incident is the deterioration and blockage in the Transfer Gear Box due failure of TGB L1 roller bearing , which could have caused the deformation of the Radial Drive Shaft leading to the In-flight engine shutdown. The reason for failure of TGB L1 bearing could not be ascertained due to missing bearing parts.

1. FACTUAL INFORMATION:

1.1 History of the Flight:

On 08th January 2024, M/s AIX Connect Pvt. Ltd., A320-214 Aircraft registration VT-VTZ was operating scheduled flight I5-1563 from Kolkata (VECC) to Bhubaneswar (VEBS) was involved in an incident of Engine In-flight shutdown during climb at Kolkata. There were 182 Persons on-board including 06 crew.

On 07th January 2024, during the night halt at Bangalore, RH dome light was replaced as there was a PDR entry that the “ RH side dome light inoperative in DIM position”. After the replaced of dome light, post installation test was carried out and found satisfactory and aircraft released for service. On the date of incident, the aircraft VT-VTZ operated 04 (four) sectors before the flight I5-1563 (Kolkata – Bhubaneswar). Nil defects were reported in these 04 sectors.

On the date of incident, the aircraft VT-VTZ was operated by the same set of flight crew from Bangalore to Bhubaneswar and thereafter from Bhubaneswar to Kolkata. After landing at Kolkata, pre-flight inspection was carried out by the AME and

the aircraft was declared serviceable. There was no snag pending on the aircraft before the incident flight.

Aircraft took off from Kolkata at 1159 UTC, at 30Nm outbound Kolkata, while climbing and passing FL180, the flight crew heard a boom sound with the aircraft yawing slightly to the left. The flight crew observed a drop in N1 for engine#1 on the EWD (Engine Warning Display). Shortly thereafter, ECAM warning 'AUTO FLT AP OFF' followed by 'ENG 1 FAIL' was annunciated.

The crew declared PAN-PAN and decided to turn back to Kolkata. The crew followed the ECAM actions and completed them in accordance with the established procedure. The aircraft thereafter made ILS approach for RWY 01R at Kolkata and landed with single engine at 1229 UTC. The aircraft taxied on its own power to the parking stand. There was no fire and injury to any of the occupants on board the aircraft.

1.2 Injuries to Person:

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	Nil/06	176	

1.3 Damage to aircraft:

There was no external damage to the aircraft. However, engine#1 had un-commanded shut down due to internal failure.

1.4 Other damage: Nil.

1.5 Personnel information:

1.5.1. Pilot in Command:

Age	44 Years / Male
Type of license	ATPL
Date of Issue	24.02.2021
Valid up to	27.02.2026
Category	Aeroplane
Date of last Class 1 Medical Assessment	05.01.2024
Medical Exam validity	04.04.2024
FRTTO Licence issued on	12.12.2012

FRTTO Licence valid up to	07.03.2026
Total Flying Experience	9000Hrs
Total Flying Hours as PIC on Type	4500Hrs
Total Flying Hours as PIC on Type (last 1 year)	862:33Hrs
Total flying experience in last 90 days as PIC	205:53Hrs
Total flying experience in last 30 days as PIC	27:32Hrs
Total flying experience in last 7 days as PIC	18:05Hrs
Total flying experience in last 24 hrs as PIC	04:15Hrs

The pilot-in-command had undergone Pre-flight BA check at Bangalore on 08th January 2024 at 05:37 UTC the result of which was negative.

1.5.2. First Officer:

Age	34 Years / male
Type of licence	CPL
Date of Issue	19.06.2013
Valid upto	18.06.2028
Category	Aeroplane
Date of last Class 1 Medical Assessment	22.06.2023
Medical Exam validity	01.07.2024
FRTTO Licence issued on	19.06.2013
FRTTO Licence valid up to	07.09.2035
Total Flying Experience	589:03Hrs
Total Flying Hours as FO on Type	238:49Hrs
Total Flying Hours as FO on Type (last one year)	155:43Hrs
Total flying experience in last 90 days as FO	04:15Hrs
Total flying experience in last 30 days as FO	04:15Hrs
Total flying experience in last 7 days as FO	04:15Hrs
Total flying experience in last 24 Hrs as FO	04:15Hrs

The First Officer had undergone Pre-flight BA check at Bangalore on 08th January 2024 at 05:05 UTC the result of which was negative. Previous to M/s. AIX Connect, the first officer flown in the other airlines till 29th April 2023. On the date of incident, he started his first SLF flight in M/s AIX Connect after completing the necessary training in the simulators.

Both the operating crew were current in all training. The licenses of both the cockpit crew and all the credentials were valid. Both the crew had adequate rest prior to roster for the incident flight. Both flight crew were qualified and current on type (A320) to operate the flight.

1.6 Aircraft Information:

1.6.1. Aircraft and Engine Details:

AIRCRAFT: - VT-VTZ		
Manufacturer		Airbus, France
Type		A320-214
Owner	Address	GASL Ireland Leasing B1 Limited, Riverside One Sir. John, Rogerson's Quay, DUBLIN 2, Ireland
	Nationality	Irish
Operator	Address	AIX Connect Private Limited, Alpha-3 Building, Ground Floor, Kempegowda, International Airport, Devanahalli, Bengaluru, Karnataka, India 560300
	Nationality	Indian
Manufacturer Serial no.		4379
Year of Manufacture		2010
Certificate of Airworthiness		7057 dated 19.09.2018
Airworthiness Review Certificate		Reference: VTZ/7057/ARC/2023/09 issued on 09.08.2023 and valid till 19.08.2024.
Category		Normal / Passenger
Certificate of Registration		Sl. No. 4954/3, Category-A
Minimum Crew Required		02
Maximum All Up weight		73,500 kg
Last major inspection		C06 C-Check performed on 13-Jun-2023 at Hyderabad.
Total Aircraft Hrs		36876.28 Hrs
Total Aircraft Cycles		27558
Status of Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications		No Airworthiness Directives, Service Bulletins, DGCA Mandatory Modifications is due on the aircraft on the date of incident.

ENGINE INFORMATION	ENGINE NO. 1	ENGINE NO. 2
Manufacturer	CFM	CFM
Engine Type & Series	CFM56-5B4/3	CFM56-5B4/3
Serial No.	699981	699982
Position	Engine#1	Engine#2
HRS done since new	35734:40	35765:25
HRS done since last shop visit	16359	18881
Cycles done since new	26635	26583
Cycles done since last shop visit	11237	12847

The last major inspection (C06 C-Check) was carried out at on 13th June 2023 at Hyderabad. Subsequently all lower inspections (Preflight checks, E021, E022 checks) were carried out as and when due before the incident.

The aircraft was last weighed on 15th July 2023 at Cochin and the weight schedule was duly approved by the office of Deputy Director General, DGCA, Bangalore. As per the approved weight schedule, the Empty weight of the aircraft is 41983 Kg. Maximum Usable fuel Quantity is 19005 Kg. Maximum payloads with fuel tanks full is 11577 Kg. Empty weight CG is 18.95 m aft of datum. As there has not been any major modification affecting weight & balance since last weighing, hence the next weighing is due on 14.07.2028. Maximum takeoff weight of the aircraft is 73500 kg and maximum landing weight of the aircraft is 66000 kg. Actual aircraft weight at takeoff and landing of the incident flight is 66352.24 kg and 65009.59 kg respectively. Prior to the incident flight the weight and balance of the aircraft was well within the operating limits.

All the concerned Airworthiness Directive, mandatory Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine had been complied with as on date of incident. The last fuel microbiological test was done through M/s. AES Laboratories Pvt Ltd, Noida on 21/11/2023 and the microbiological growth was negligible.

The Engine#1 S/N 699981 had logged TSN 35734:40 Hrs and CSN 26635 cycles and the Engine #2 S/N 699982 had TSN logged 35765:25 Hrs and CSN 26583 cycles. There was no defect report on the engine on the previous flight. The affected Engine CFM56-5B4/3 S/N.699981 was last sent to shop on 14th July 2018 at GeCelma. During the last shop visit, RDS removed from the engine with no findings on these RDS. The roller bearing was not replaced. The tool used was 856A2727 for the re-installation of the RDS. TGB was removed and visually inspected during this shop visit.

1.6.2. System Description:

The CFM56-5A/-5B engine is a high by-pass, dual rotor, axial flow, advanced technology turbofan. It is supported by the wing pylon and streamlined by cowlings. Air is sucked into the intake by the fan blades and split into two flow paths, the Primary and the Secondary. The primary airflow passes through the inner portion of the fan blades and is directed into a booster (LPC). The secondary airflow passes through the outer portion of the fan blades, the Outlet Guide Vanes (OGV's) and exits through the nacelle discharge duct, producing approximately 80% of the total thrust. It also plays a role in the thrust reverser system.

At static take-off power, the CFM56-5B engine by-pass ratio is between 5.4:1 and 6:1, depending on the engine model, which means that the secondary airflow takes in between 5.4 and 6 times more air than the primary airflow.

The design and configuration of the engine are based on obtaining long life high reliability and easy access for line maintenance. It is a modular design which permits the changing of a major assembly without complete disassembly of the engine. The 3 major modules of the engine are the Fan Major Module, Core Engine Major Module and Low-Pressure Turbine Major Module.

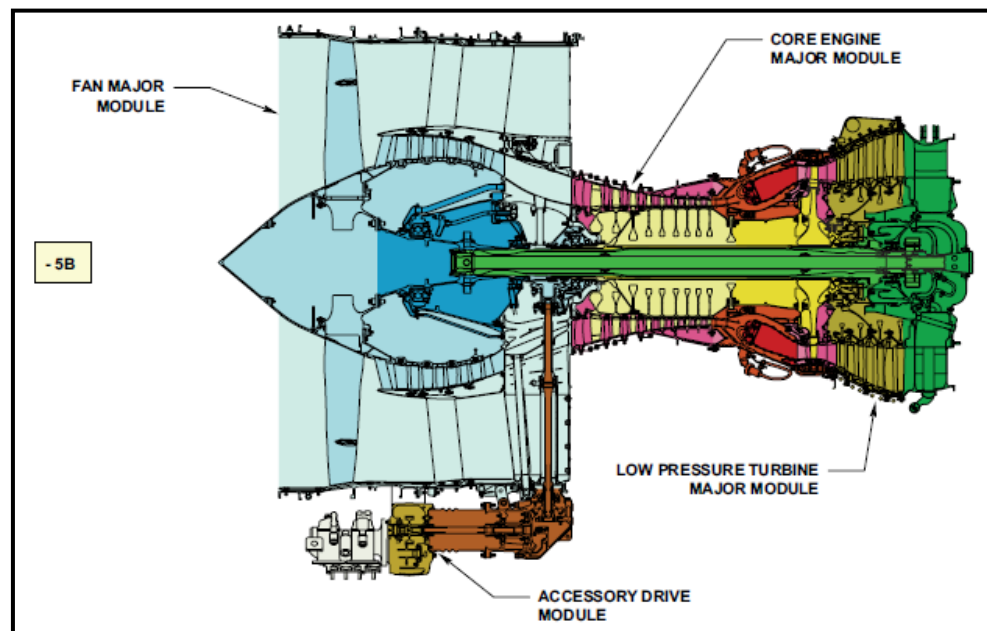


Figure 1: CFM56-5B Engine Modular Design

Fan Frame Module:

The fan frame is one of the major structural and aerodynamic components of the engine. Aerodynamically the fan frame forms the inner and outer flow passage of the fan airstream as well as the core airstream.

Structurally, it carries inlet cowl loads, supports the fan casing, the two fan bearings and the core engine forward bearing; it contains the forward engine mount, it houses the accessory drive power take off gearbox and radial drive shaft; it contains the variable bypass valves between the booster and high-pressure compressor; it supports the transfer and accessory gearboxes; and provides the mounting surfaces for fan-stream acoustic panels.

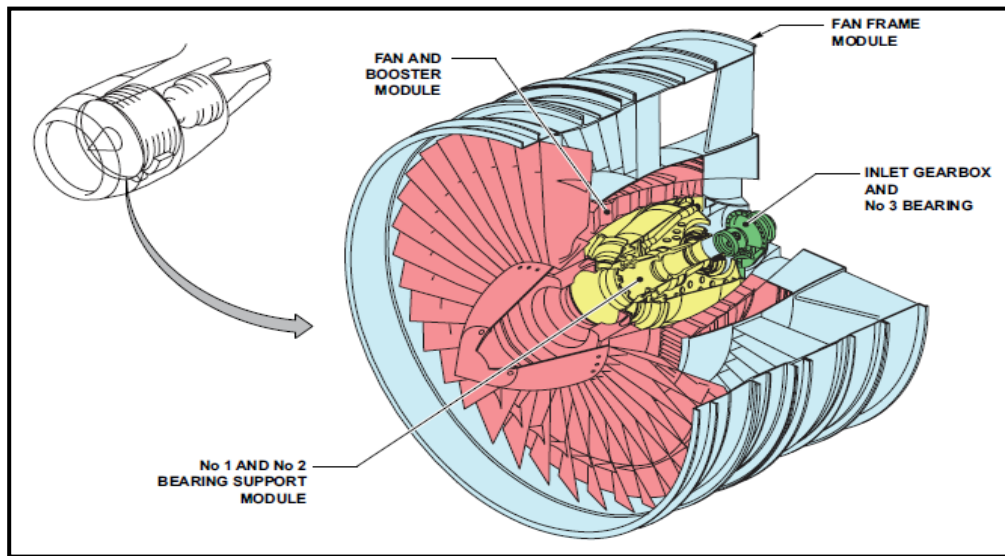


Figure 2: Fan Major module

Accessory Drive Section Design:

At engine start, the accessory drive system transmits external power from the engine air starter to drive the core engine. When the engine is running, the accessory drive system extracts part of the core engine power and transmits it through a series of gearboxes and shafts in order to drive the engine and aircraft accessories. For maintenance tasks, the core can be cranked manually through the Accessory Gearbox. The accessory drive system is located at the 6 o'clock position and consists of the following components:

- Inlet Gearbox (IGB), which takes power from the HPC front shaft.
- Radial Drive Shaft (RDS), which transmits the power to the Transfer Gearbox.
- Transfer Gearbox (TGB), which redirects the torque.
- Horizontal Drive Shaft (HDS), which transmits power from the Transfer Gearbox to the Accessory Gearbox.
- Accessory Gearbox (AGB), which supports and drives both engine and aircraft accessories.

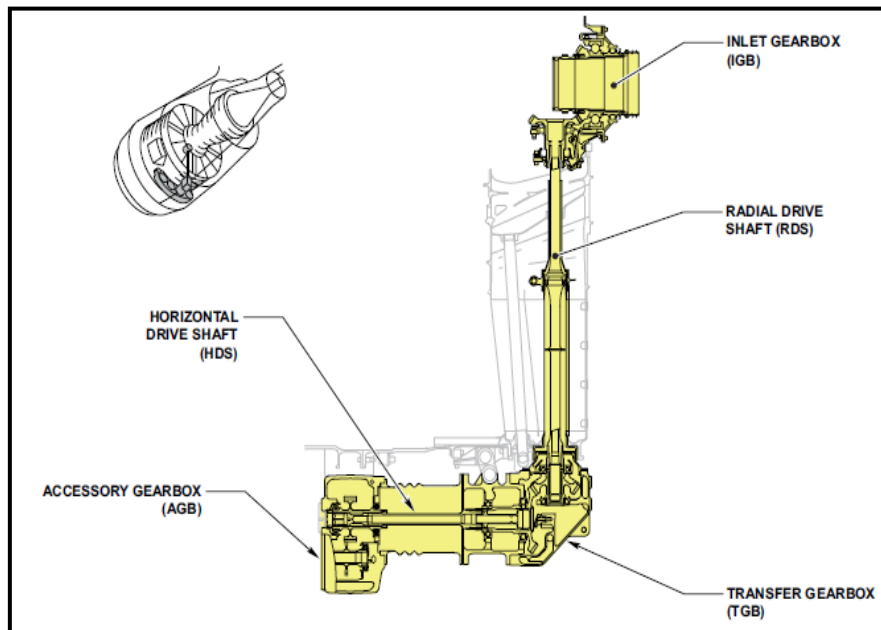


Figure 3: Accessory Drive Section Design

Transfer Gearbox Assembly Description:

Driven by the RDS, the Transfer Gearbox reduces rotational speed and redirects the torque from the IGB to the AGB, through the horizontal drive shaft.

It is secured under the fan frame module at the 6 o'clock position and consists of:

- The gearbox housing.
- The input bevel gear.
- The horizontal bevel gear.

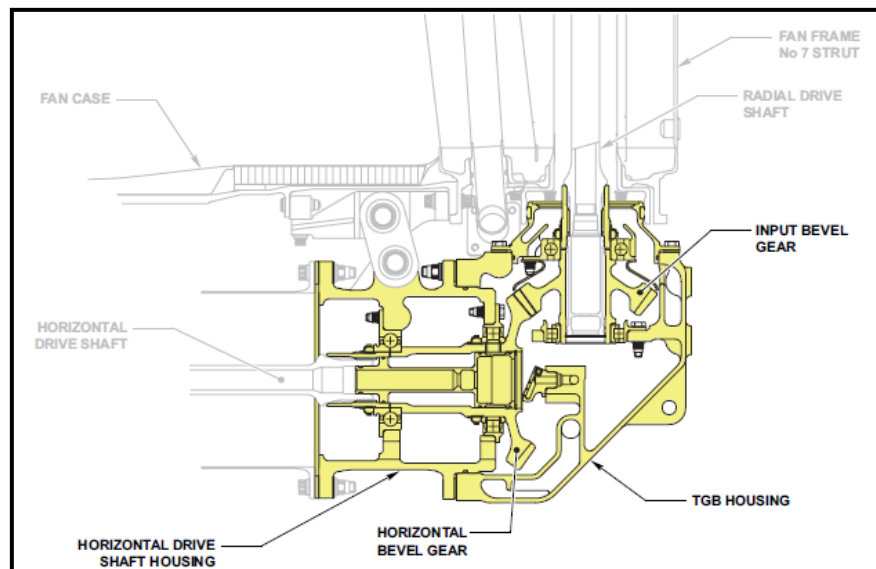
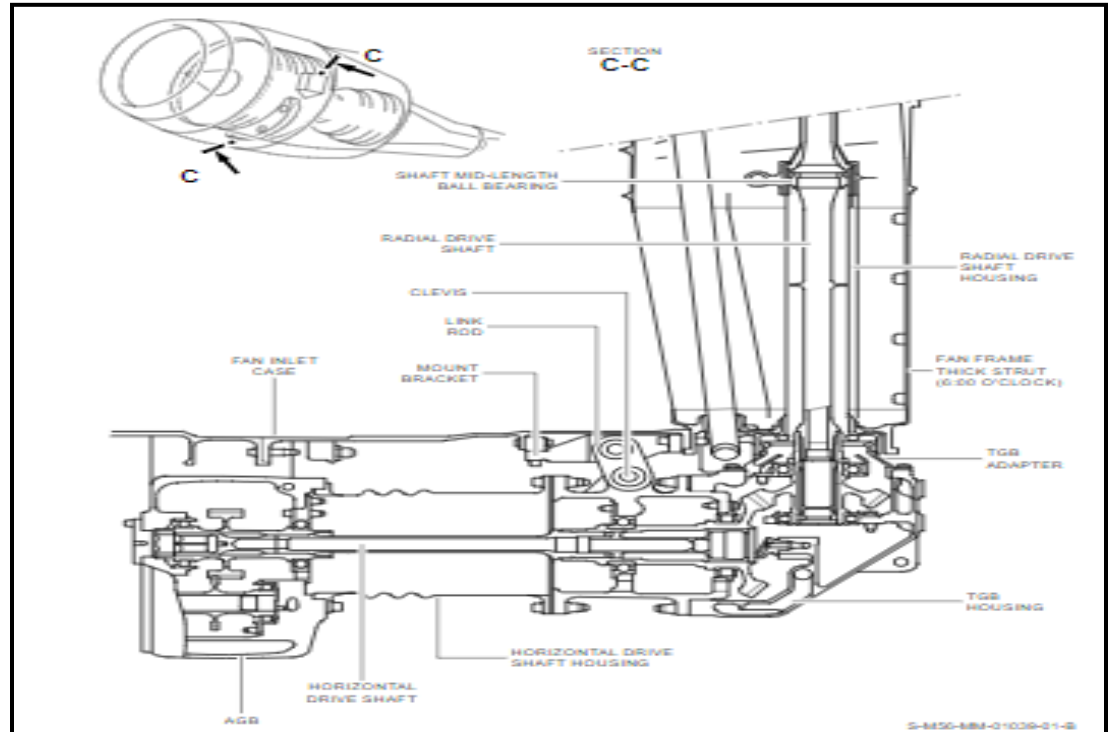


Figure 4: Transfer Gearbox Assembly

Radial Drive Shaft Assembly:

The radial drive shaft (RDS) assembly is installed inside the fan frame No. 7 strut at the 6 o'clock position. It consists of the radial drive shaft and the shaft mid-length bearing.

(2) The shaft mid-length bearing provides proper centering of radial drive shaft in its housing. Its inner race is mounted half-way up on the RDS and the outer race is part of the radial drive shaft housing.



- 1.6.3.1. The defect entry of "Boom noise at 18000ft followed by engine#1 fail on ECAM. Completed ECAM procedure and landed back to CCU. Uneventful landing & safe" was entered in the MR1.
- 1.6.3.2. Post arrival engine 1 oil level was found at 13 QTZ. Fan frame strut # 07 was damaged along with radial drive shaft outer casing. No faults were detected in operational test of FADEC 1A & 1B with engine non motoring.
- 1.6.3.3. Fan & LPT stage 4 blades were checked for free rotation, found satisfactory.
- 1.6.3.4. EMCD visual indicator was pop out and particles were accumulated on EMCD magnetic detector. The check of the scavenge screens revealed particles in TGB screen. VBV (Variable bleed valve) system checked and found satisfactory. Fuel filter cartridge inspected and no contamination observed.
- 1.6.3.5. **Damages observed along with strut:** Fan duct panel @05:30 position corner area crack-adjacent right to the damaged strut. Aft acoustic panel liner stuck with damaged strut @6:30 position.

1.6.3.6. Borescope inspection of LPC, LPT and combustion chamber was satisfactory. HPC & HPT borescope was not performed due inability to rotate HP spool. Engine declared as unserviceable.

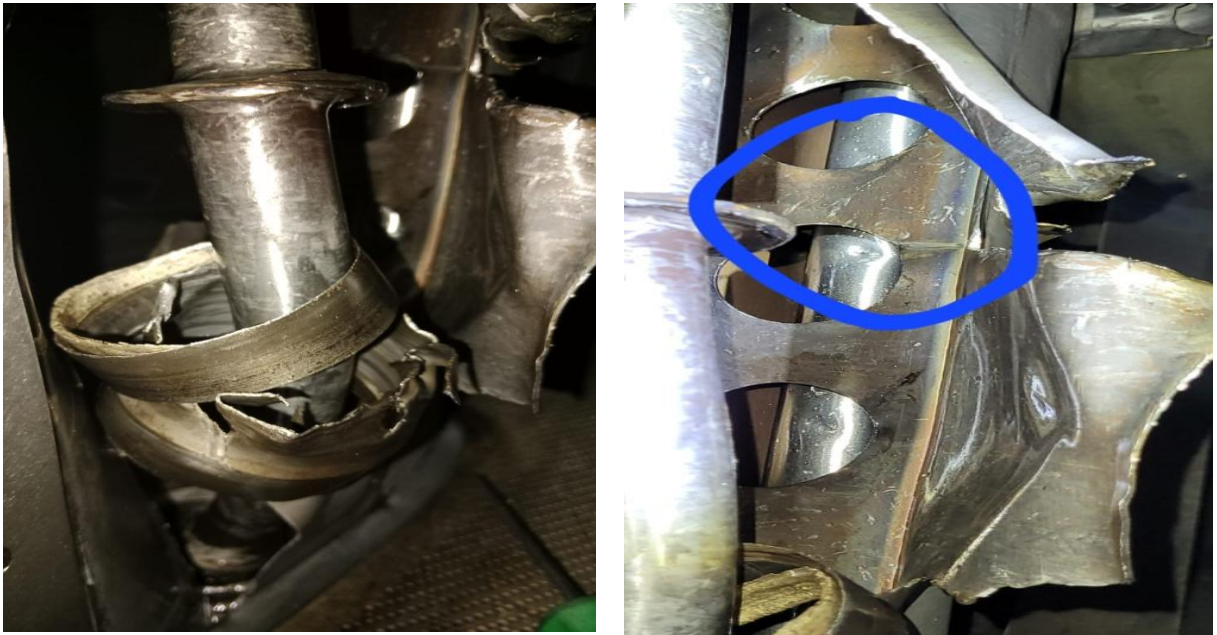


Figure 6: Damages on the Fan frame strut #7

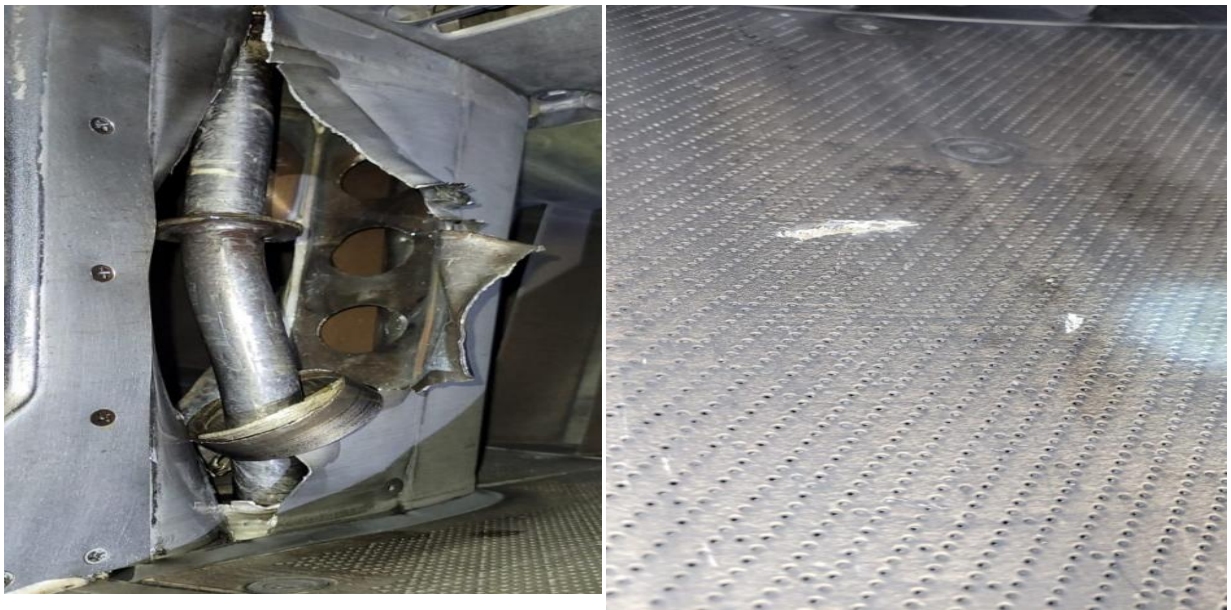


Figure 7: Damages on the Fan frame strut #7 and RDS outer casing

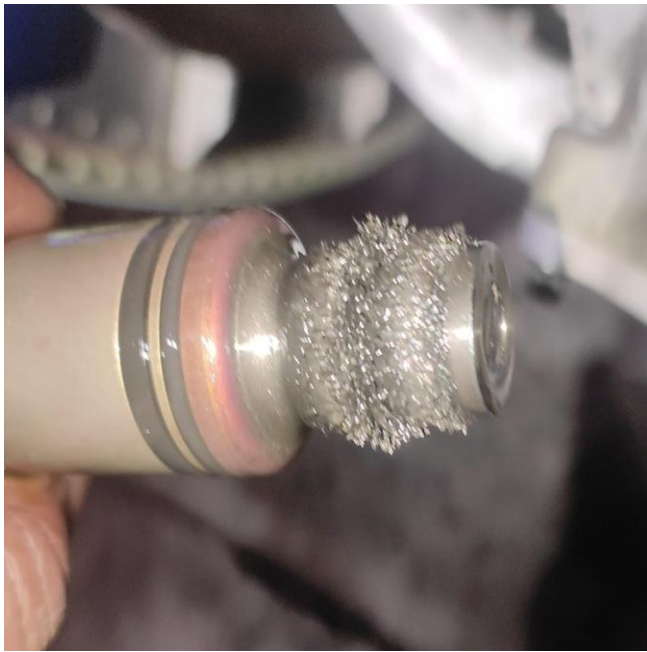


Figure 8: EMCD magnetic detector



Figure 9: TGB scavenge screen

1.6.4. Customer notification Report (CNR):

The CFM56-5A/-5B engine uses a maintenance concept called ‘On Condition Maintenance’. This means that the engine has no periodic overhaul schedules and can remain installed under the wing until something important occurs, or when lifetime limits of parts are reached.

For this reason, to monitor and maintain the health of the engine, different tools are available, which are:

- Engine performance trend monitoring
- Borescope inspection
- Lubrication particles analysis
- Engine vibration monitoring system

During the engine condition monitoring, Customer Notification Reports (CNR) are generated by M/s.CFM for their customers and the CNR will be issued with some recommendations to the customers based on the engine performance trend monitoring.

The analysis and recommendations provided in the CNRs are based on the experience with hardware and repairs approved by the applicable OEM for the subject engine model. Maintenance recommendations, including timing, contained in the CNR are based on overall fleet knowledge and experience. Because there is significant variation in aircraft and engine operations, individual operators may have additional data, analyses, or other information that allows discretion regarding timing and specific maintenance performed. Timing recommendations are provided on general priority and should not be considered a firm limit.

CNRs are classified with class and level. Each of which specifies recommended maintenance actions and priority.

- Class A – For scenarios where published ICA is not available to manage a new or emerging field issue that is detectable by diagnostics data. The CNR can provide

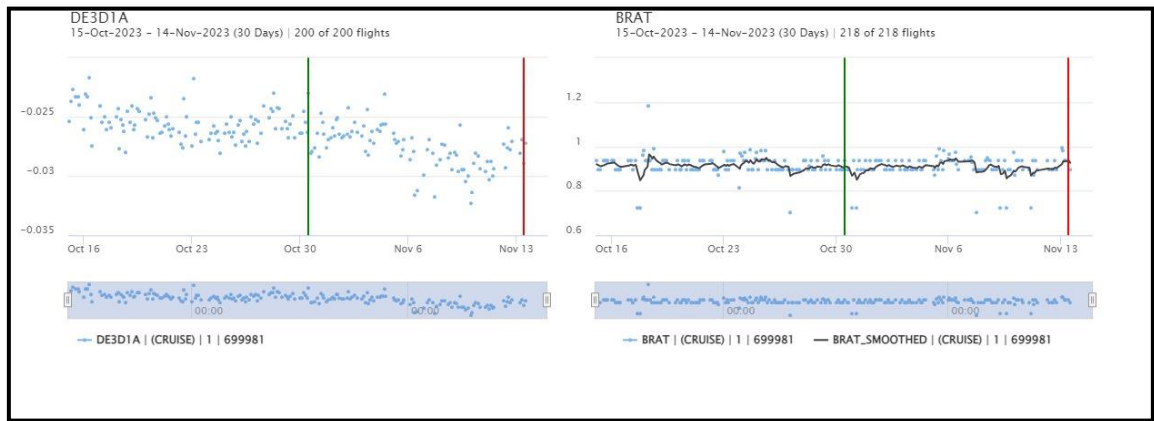
maintenance recommendations supplementary to ICA until a published ICA is issued or updated to address the issue. This classification will be restricted to a small subset of all CNRs. If the Class A CNR signals are confirmed by the operator, findings will be reported to the certifying agency(s).

- Class A, Level 1 (formerly Critical): Recommend actions taken before the next flight.
 - Class A, Level 2 (formerly Urgent): Intended to be short term to re-position aircraft for maintenance.
- Class B – This classification will be used for general health and diagnostics monitoring recommendations that refer to an existing ICA, similar to current CNRs. The majority of all CNRs will be Class B.
- Class B, Level 1 (formerly Critical): Recommend actions taken before the next flight
 - Class B, Level 2 (formerly Urgent): Intended to be short term to re-position aircraft for maintenance
 - Class B, Level 3 (formerly Normal): Intended to address CNR at operator convenience. M/s.CFM fleet experience indicates that action within 30 days of CNR issuance has been effective timing in minimizing unplanned maintenance action.

M/s AIX Connect Pvt Ltd received CNR 20231114070 dated 14th November 2023 from M/s.CFM with CNR Class B and Level 3 on engine serial number 699981 installed on VT-VTZ as Engine position #1. During analysis by M/s.CFM for the period from 30th October 2023 to 13th November 2023, it was observed that the engine has experienced a gradual decrease in overall HPC compression efficiency, which prompted to issue the subject CNR. Further, M/s.CFM recommends to perform the engine wash as per AMM task 72-00-00-100-008-A. For best results, M/s.CFM recommends using detergent based cleaning agent wash as per AMM 72-00-00-100-028-A.

Below are engine trend table and charts prepared by M/s.CFM monitoring team for the subject CNR (20231114070).

Parameter Description	Flight phase	Engine Position	Value at Start Date	Value at End Date	Overall Change
Compressor Efficiency	Cruise	1	-0.0230	-0.0269	-0.0039
Bleed Flow Ratio	Cruise	1	0.9112	0.9363	0.0251

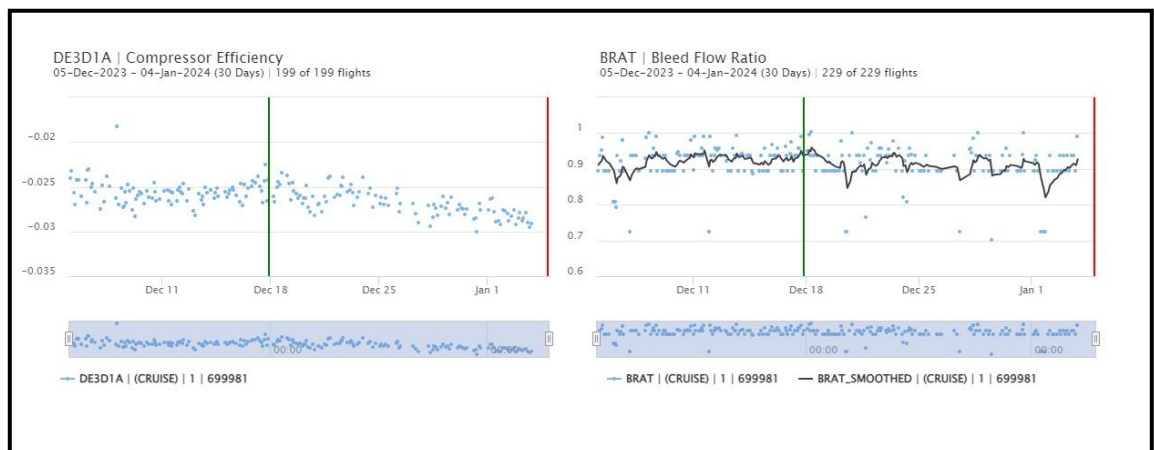


In order to comply with the recommendations made by the M/s.CFM, work order for the said task was raised on 15th November 2023 and carried out engine#1 detergent based water wash as per AMM 72-00-00-100-028-A on 22nd November 2023.

Thereafter, similar CNR for the same engine was issued on 04th January 2024 with CNR 20240104050 with CNR Class B and Level 3. During analysis by CFM for the period from 17th December 2023 to 04th January 2024, it was observed that the engine has experienced a gradual decrease in overall HPC compression efficiency, which prompted to issue the subject CNR. Further, CFM recommends to perform the engine wash as per AMM task 72-00-00-100-008-A. For best results, CFM recommends using detergent based cleaning agent wash as per AMM 72-00-00-100-028-A.

Below are engine trend table and charts prepared by M/s.CFM monitoring team for the subject CNR (20240104050).

Parameter Description	Flight phase	Engine Position	Value at Start Date	Value at End Date	Overall Change
Compressor Efficiency	Cruise	1	-0.0242	-0.0291	-0.0049
Bleed Flow Ratio	Cruise	1	0.9387	0.9918	0.0531



In order to comply with the recommendations made by the M/s. CFM, work order for the said task was raised on 05th January 2024 with the due date of 08th January 2024. However, the said task was not performed (The CNR issued by M/s.CFM was Level 3 allowing customer 30 days to carry out the recommended action) as the subject engine was involved in the incident of auto in-flight shut down on 08th January 2024 and the same was removed as unserviceable from the aircraft for its shop visit on 10th January 2024.

Further, Power plant team of M/s. AIX Connect Pvt Ltd confirmed that there is **NIL** engine parameters exceedance on the CFM portal monitoring since the issuance of CNR (20240104050) on 04th January 2024 till the event flight.

1.6.5. Life time Limited parts (LLP)

Life time Limited parts list for the CFM 56-5B Engine Serial No.699981 are as follows. All the parts life time are within the limit.



CFM56-5BX/3 Life Limited Parts List - Outgoing Status

ENGINE S/N: 699981			TSN:35735			CSN:26635			CUST.: I5		WO.: 5247140088			
IIN	DESCRIPTION	P/N	S/N	TSN	CSN	THRUST RATING LEVEL CYCLES								REMARKS
						LEVEL	IND. USED %	LIMIT	IND. LIMIT	CYCLES	% USED	% REMAINING	REMAINING	
211	SPOOL ASSY-BOOSTER	338-001-906-0	HB457390	16 360	11 237	5B4/3		30 000		11 237	37,4567	62,5433	18763	SAME
213	DISK ASSY-FAN	338-001-504-0	MA524112	16 360	11 237	5B4/3		30 000		11 237	37,4567	62,5433	18763	SAME
221	SHAFT ASSY-FAN	338-010-601-0	DY688573	16 360	11 237	5B4/3		30 000		11 237	37,4567	62,5433	18763	SAME
312	SHAFT-CPRSR ROTOR	1386M56P03	GWN139GE	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
313	SPOOL ASSY STG 1&2	1558M31G07	FG80GL29	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
314	DISK STG 3	2116M23P01	XAE1573U	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
315	SPOOL STAGES 4-9	2048M20G04	GWN135K8	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
316	SEAL ROTATING AIR REAR	2116M25P01	GFF5K853	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
521	SHAFT HPT ROTOR FRONT	2048M21P03	XAEMH393	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
522	SEAL ROTATING AIR HPT FRONT	2116M20P02	TMT1305C	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
525	DISK HPT ROTOR	1498M43P07	GWN138C2	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
526	SHAFT HPT REAR	1864M90P04	TMTDU390	16 360	11 237	5B4/3		20 000		11 237	56,1850	43,8150	8763	SAME
541	CASE LPT	338-117-407-0	DE450539	35 735	26 635	5B4/3		NIL		26 635	N/A	N/A	NIL	SAME
542	DISK LPT STG 1	336-001-804-0	PC746375	16 360	11 237	5B4/3		25 000		11 237	44,9480	55,0520	13763	SAME
543	DISK LPT STG 2	336-001-909-0	PC758723	16 360	11 237	5B4/3		25 000		11 237	44,9480	55,0520	13763	SAME
544	DISK LPT STG 3	336-002-006-0	PC764759	16 360	11 237	5B4/3		25 000		11 237	44,9480	55,0520	13763	SAME
545	DISK LPT STG 4	336-002-105-0	PC769039	16 360	11 237	5B4/3		25 000		11 237	44,9480	55,0520	13763	SAME
546	SUPPORT-RTR LPT	340-301-702-0	HB381763	16 360	11 237	5B4/3		25 000		11 237	44,9480	55,0520	13763	SAME
551	SHAFT-LPT	338-010-005-0	PC759771	16 360	11 237	5B4/3		25 000		11 237	44,9480	55,0520	13763	SAME
561	FRAME ASSY-LPT	338-171-707-0	PA498322	35 735	26 635	5B4/3		NIL		26 635	N/A	N/A	NIL	SAME

REMARKS:

Prepared by: Ya Xunong

Stamp:

Checked by: Fu Wenyong

Stamp:

DATE: 9/10/2024

1.6.6. FCOM Extract for Abnormal and Emergency procedure for Engine fail

AIX A318/A319/A320/A321 FLIGHT CREW OPERATING MANUAL	PROCEDURES ABNORMAL AND EMERGENCY PROCEDURES ENG																						
ENG 1(2) FAIL																							
Ident: PRO-ABN-ENG 00017982.0002001 / 06-Jun-16 Criteria: 31-1267, 31-1300, P9107, SA Applicable to: ALL																							
ANNUNCIATIONS <u>Triggering Conditions:</u> 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. <u>Flight Phase Inhibition:</u> <table border="1"> <thead> <tr> <th>Flight Phase</th> <th>Alert Status</th> </tr> </thead> <tbody> <tr><td>1</td><td>OFF</td></tr> <tr><td>2</td><td>OFF</td></tr> <tr><td>3</td><td>OFF</td></tr> <tr><td>4</td><td>OFF</td></tr> <tr><td>5</td><td>ON</td></tr> <tr><td>6</td><td>ON</td></tr> <tr><td>7</td><td>ON</td></tr> <tr><td>8</td><td>OFF</td></tr> <tr><td>9</td><td>OFF</td></tr> <tr><td>10</td><td>OFF</td></tr> </tbody> </table>		Flight Phase	Alert Status	1	OFF	2	OFF	3	OFF	4	OFF	5	ON	6	ON	7	ON	8	OFF	9	OFF	10	OFF
Flight Phase	Alert Status																						
1	OFF																						
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10	OFF																						

Continued on the next page

 A318/A319/A320/A321 FLIGHT CREW OPERATING MANUAL	PROCEDURES ABNORMAL AND EMERGENCY PROCEDURES ENG
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Ident: PRO-ABN-ENG 00017667.0003001 / 04-Jun-19
 Criteria: P5706, P7125, SA
 Applicable to: VT-APJ, VT-GWH, VT-HYD, VT-IMP, VT-IXR, VT-JRT, VT-KOC, VT-KUL, VT-NAG, VT-PNQ, VT-VTZ

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. L2

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:** L1

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. L2

ENG (AFFECTED) RELIGHT CONSIDER L1

If no damage, a new start sequence may be initiated. L2

ASSOCIATED PROCEDURES

ENG 1(2) SHUT DOWN L12

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:** L1

ENG MODE SEL IGN L2

Selection of continuous ignition confirms the immediate relight attempt made by the FADEC.

THR LEVER (AFFECTED ENGINE) IDLE L1

Continued on the next page

 A318/A319/A320/A321 FLIGHT CREW OPERATING MANUAL	PROCEDURES ABNORMAL AND EMERGENCY PROCEDURES ENG
<u>Note:</u> In case of GPWS (EGPWS ) 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 ) 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) RELIGHTCONSIDER Apply ENG RELIGHT (in flight) procedure (Refer to PRO-ABN-ENG [QRH] ENG RELIGHT IN FLIGHT).	L2 L1 L2 L1 L12 L2

1.7 Meteorological information:

The meteorological data of the Kolkata Airport on the date of incident (08th January 2024) is as follows:

Time	Wind	Cloud	Temp	Visibility	QNH	Trend
1100 UTC	330/05 kt	NSC	23°C	2400 m	1015	NOSIG
1130 UTC	340/05 kt	NSC	22°C	2400 m	1015	NOSIG
1200 UTC	340/06 kt	NSC	21°C	2400 m	1016	NOSIG
1230 UTC	350/05 kt	NSC	20°C	2200 m	1016	NOSIG
1300 UTC	010/03 kt	NSC	20°C	2400 m	1016	NOSIG

1.8 Aids to Navigation:

Kolkata Airport is equipped with navigational aids like ILS, DME, DVOR, PAPI etc. No limitation on serviceability / use of any navigational aid was reported by the ATC at the time of incident. Further, no unserviceability or non-availability of any navigational aid was reported by the flight crew of VT-VTZ during any phase of flight.

1.9 Communication:

There was all the time two-way communication between Kolkata ATC and the flight crew of VT-VTZ during the entire flight. Aircraft is equipped with Very High Frequency transmitter and receiver set and High Frequency transmitter and receiver set.

1.10 Aerodrome information:

NSCBI Aerodrome (VECC) located in Kolkata and is about 15 Km from the Howrah Railway Station. The aerodrome is operated and maintained by M/s Airport Authority of India and is spread over 1577.3 acres. Kolkata aerodrome has two parallel runways, 19L-01R as the primary runway and 19R-01L as the secondary runway. The main runway is equipped with CAT-III lighting system on 01R approach and CAT-II lighting system on 19L approach to provide visual aids to aircraft during low visibility conditions. The secondary runway is provided with CAT-I lighting system on 19R side and simple approach lights on 01L side. The ARP co-ordinates are 22° 39' 14" N & 88° 26' 48" E.



Google earth image of NSCBI Aerodrome, Kolkata

1.11 Flight Records:

The aircraft was fitted with SSCVR and SSFDR. After the incident at Kolkata, both were replaced and downloaded. The data was retrieved and utilized in the investigation.

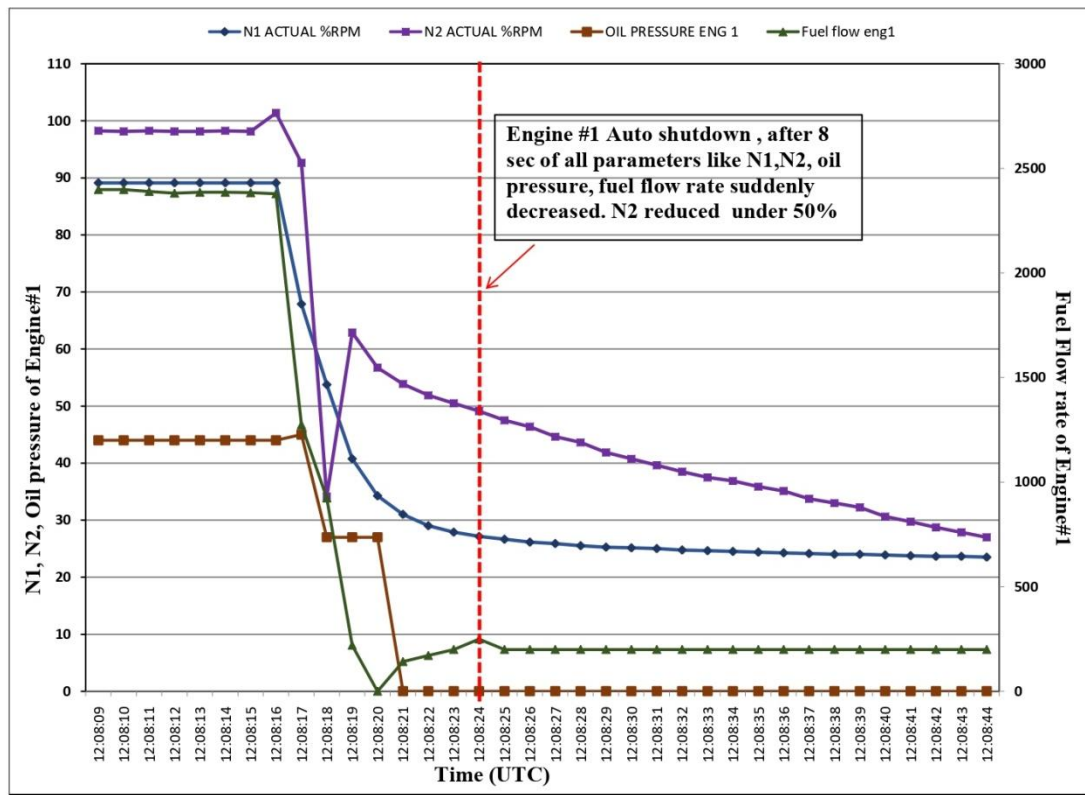
1.11.1. CVR:

The aircraft VT-VTZ fitted with L3 Harris Aviation products Inc CVR with part number 2100-1026-02 serial No. 000966102. From the CVR it is established that PIC reported engine failure at FL180 and declared PAN PAN and requested for priority landing. The corresponding thrust lever was put to idle and flight crew informed ATC that they will land back to Kolkata Airport. Flight crew also performed engine relight actions and after unsuccessful relight attempt, engine#1 master was switched off. Weather was reported as 2400 m visibility and wind 06 knots with no significant clouds. Flight landed at Kolkata airport safely thereafter. The complete CVR transcript is given in Appendix A.

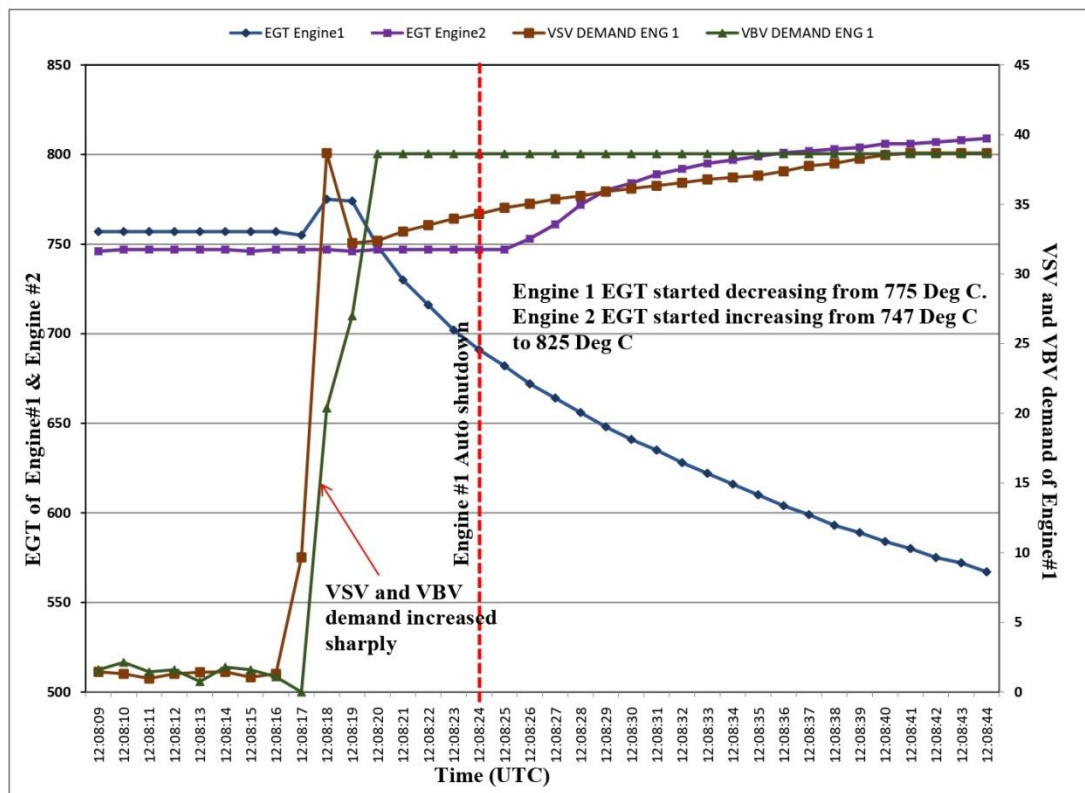
1.11.2. DFDR:

The aircraft VT-VTZ fitted with L3 Harris Aviation products Inc DFDR with part number 2100-4045-00 serial No. 000905063. The following are relevant DFDR analysis:

- At 12:08:17 UTC, engine 1 N1 speed decreased abruptly from 89.13 % to 67.88 % and continued to decrease further.
- At 12:08:18 UTC, engine 1 oil pressure decreased abruptly from 45 psi to 27 psi and further decreased to 0 psi at 12:08:21 UTC.
- From 12:08:18 UTC, engine 1 Exhaust Gas Temperature (EGT) started decreasing from 775 °C. Engine 2 EGT started increasing at 12:08:26 UTC from 747°C to 825°C at 12:10:41 UTC.
- Engine 1 fuel flow abruptly decreased from 2379 kg/hr (at 12:08:16 UTC) to 0 kg/hr (at 12:09:45 UTC).
- At 12:08:15 UTC, the Variable Bleed Valve position was 1.59 Deg. The angle sharply increased to 20.38 Deg within 2 seconds. At 12:08:15 UTC, the Variable Stator Vanes position was 1.31 Deg. The angle sharply increased to 38.69 Deg within 01 seconds.
- At 12:08:16 UTC, engine 1 transferred pressure abruptly decreased from 84 to 0 within 02 seconds. PB burner system 1 decreased from 220.25 psi to 16 psi within 08 seconds.
- At 12:08:16 UTC, before the engine 1 power loss, the calibrated Airspeed was 278 kts which started decreasing progressively.
- After engine 1 power loss at 12:08:16 UTC, the aircraft climbed till 18312 feet (at 12:09:40 UTC) before starting the descent for air return to Kolkata.
- At 12:08:24 UTC, Engine #1 auto shutdown, after 8 sec of all parameters like N1, N2, oil pressure, fuel flow rate suddenly decreased.



Graph 1: Time (UTC) vs N1, N2, Oil pressure of Engine #1 in primary axis and Fuel flow rate of Engine#1 in Secondary axis



Graph 2: Time (UTC) vs EGT of Engine #1 and Engine#2 in primary axis and VSV & VBV demand of Engine#1 in Secondary axis

1.12 Wreckage and impact information:Not applicable.

1.13 Medical and pathological information: Not applicable.

1.14 Fire:

There was no fire or smoke during or after the incident.

1.15 Survival aspects:

The incident was survivable.

1.16 Test and Researches:

1.16.1. Airbus response on Incident of Engine Auto In-flight Shutdown

M/s. AIX Connect Pvt Ltd requested M/s Airbus to conduct a thorough investigation of the provided data to identify the root cause of the incident to know how and why the subject incident has occurred and requested to provide any maintenance actions deemed necessary. In response, M/s. Airbus proposed to M/s. AIX Connect Pvt Ltd to carry out engineering request under a Critical aspect since this issue is not under AOG scope of activity and advised to liaise with the engine manufacture (i.e M/s.CFM).

Further, M/s. Airbus provided the information to M/s. AIX Connect Pvt Ltd that “Airbus understands that the maintenance team performed inspections and found oil leaking around the No.7 Strut area. Further inspection revealed oil seeping through the ventilation hole in the No.7 Strut and deformation mark on the No.7 Strut as well. Master Chip Detector (MCD) inspection was carried out and metal particles were found. The metal particles were not sent to the laboratory for investigation. Based on M/s. Airbus and M/s.CFM experience, the oil leak in addition to the No.7 Strut deformation have led to the conclusion that the Radial Drive Shaft (RDS) bearing failure is the root cause of this event.

1.16.2. Preliminary Engineering Highlight by M/s. MTU maintenance

The engine#1 (ESN # 699981) was removed from VT-VTZ on 09th January 2024 and was sent to Engine Shop (M/s MTU maintenance, China) for the investigation. M/s. MTU Maintenance carried out the preliminary Engineering assessment on the subject engine and the followings were observed.

S.no	Parts	Findings / Remarks
1	Fan Major Module	Found fan blade leading edge with distortion
2	Fan disk & Booster	General condition is satisfactory
3	No.1 & 2 bearing support	General condition is satisfactory
4	Fan frame	• Found fan frame strut 7 significant damage • Found RDS shaft broken • Found RDS housing significant worn • Found 4EA OGVs leading edge missing

		metal material
5	IGB Module	General condition is satisfactory except 35 teeth bevel gear spline wear
6	Core major Module	General condition is satisfactory HPC stage 1&2 VSV ring bushing missing
7	LPT Major Module	General condition is satisfactory
8	Turbine Rear Frame -TRF	Found NO.5 BRG support cracked
9	Transfer Gear Box – TGB	Found TGB with excessive damage
10	AGB	Found large amount debris in AGB lower area
11	Accessories	General condition is satisfactory

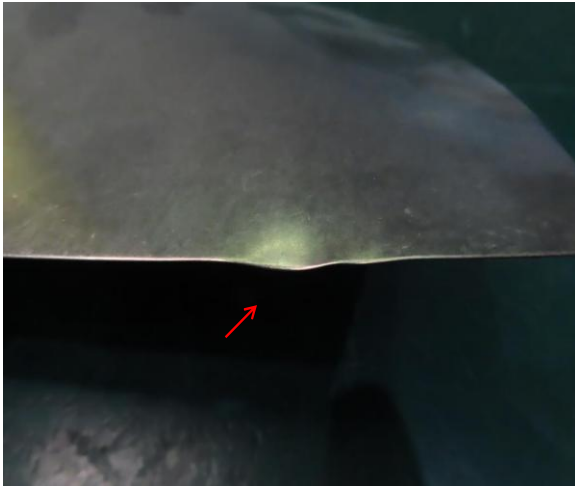


Figure 9: Fan blade leading edge with distortion



Figure 10: Fan frame strut 7 significant damage



Figure 11: Fan frame strut 7 significant damage



Figure 12: RDS housing worn



Figure 13: Outer housing broken and wear



Figure 14: OGV Leading edge metal sheet un-bond

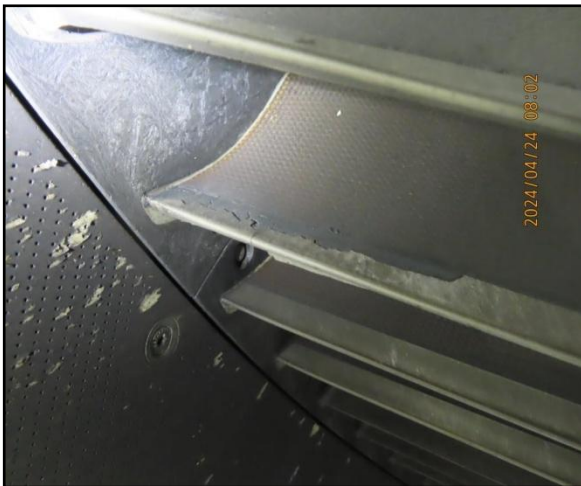


Figure 15: OGV metal sheet missing material



Figure 16: Middle acoustical panel impact damage



Figure 17: After acoustical panel DOD damage



Figure 18: FWD oil stationary seal seized with IGB



Figure 19: TGB input adapter security bolt with wrong safety



Figure 20: TGB housing excessive damage and wear



Figure 21: TGB housing excessive damage and wear



Figure 22: RDS shaft broken



Figure 23: RDS Bearing missing



Figure 24: Output gear damage



Figure 25: TGB input shaft excessive damage



Figure 26: Large amount debris in AGB lower area

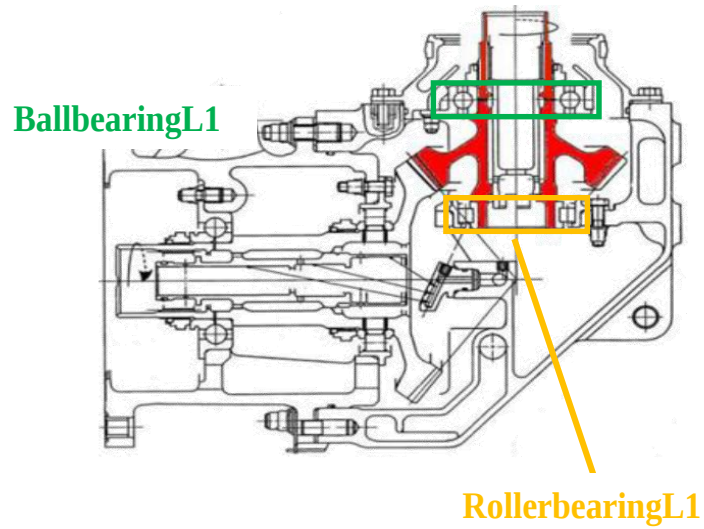
1.16.3. Event analysis by engine OEM M/sCFM based on the shop findings.

M/s. CFM made an event analysis based on the shop finding made by the M/s. MTU maintenance, China for the Engine 699981 CFM56-5B4/3 experienced an IFSD on 08th January 2024 and arrived at the following conclusion.

- DFDR analysis results indicate observation of all parameters (N2, N1, Fuel Flow, oil pressure) suddenly to decrease in few seconds. That is coherent with RDS housing, RDS and TGB findings observed during first inspections. The engine 1 auto shut down 8s after all parameters suddenly decreased (N2 became under 50%).
- The event of IFSD exhibited heavy parts worn out & missing parts on both TGB and RDS.
- Heavy parts worn out & missing parts make the root cause origin to be difficult to identify, however lower section of the bent RDS let us suspect that a blockage in the TGB could have caused the deformation of the RDS and then RDS to fail after.
- Suspected root cause of the TGB deterioration is the result of the TGB L1 roller bearing.
- Root cause failure of the TGB L1 roller bearing not identified due to missing parts (bearing roller elements, races, ball bearing and heavy wear on TGB parts).
- Most probable scenario for the IFSD in sequence is



- L1 roller bearing failure
- L1 ball bearing failure
- L1 and RDS orbiting
 - ✓ L1 gear shaft wear
 - ✓ RDS roller bearing
 - ✓ RDS Inner Housing
 - ✓ RDS shroud torn
 - ✓ Fan Frame Strut damaged
- RDS destruction by a RDS blockage in the TGB Housing
- Engine stop, IFSD



- Comparison of Radial drive shaft housing:



Figure 27: Comparison of RDS inner housing upper side remaining section with good condition



Figure 28: Comparison of RDS outer housing upper side remaining section with good condition

➤ Inspection on Radial drive shaft condition:

Inspection on the radial drive shaft reveals that the RDS got bent/distorted and broken, splines on TGB side very worn and marked, roller bearing deteriorated, missing rollers, cage melted, inner race present and vespel nut worn out.

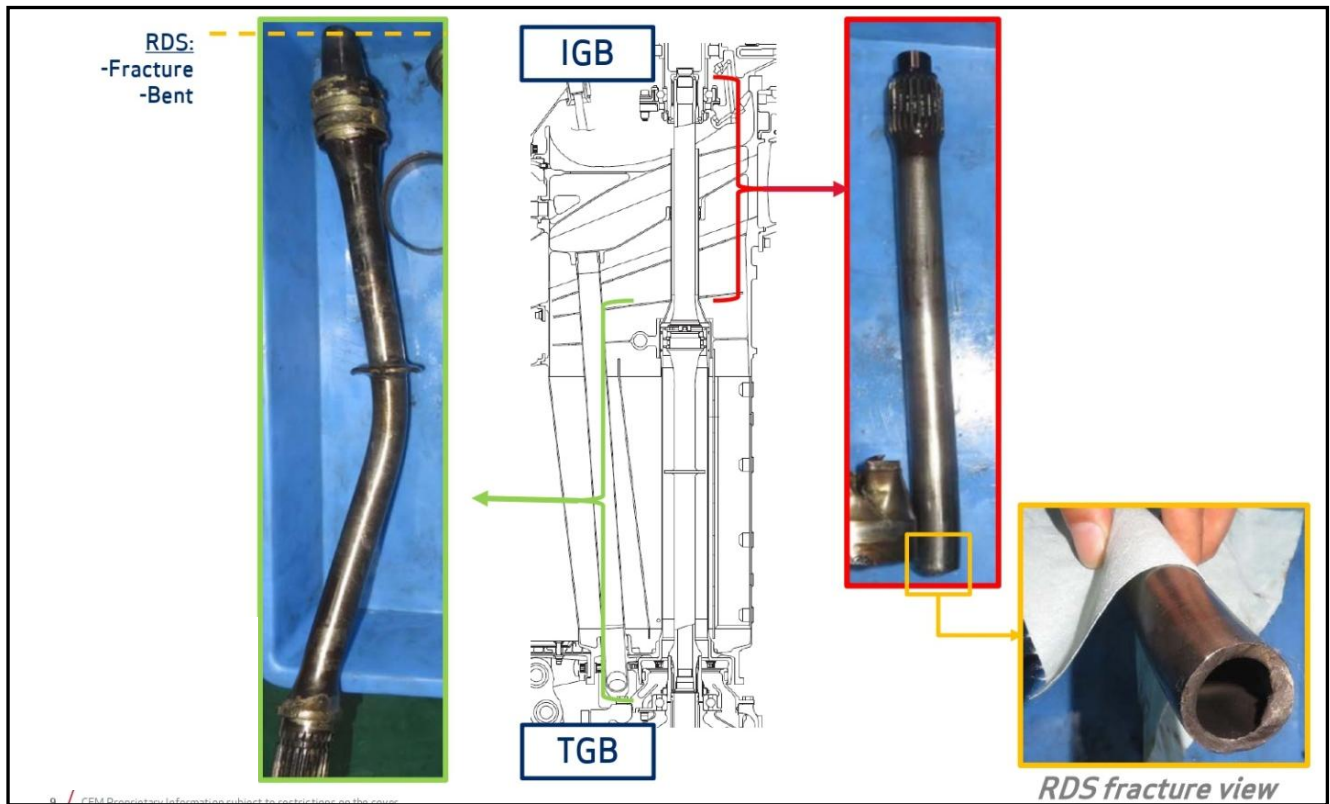


Figure 29: Inspection of radial shaft condition (Source: M/s CFM)

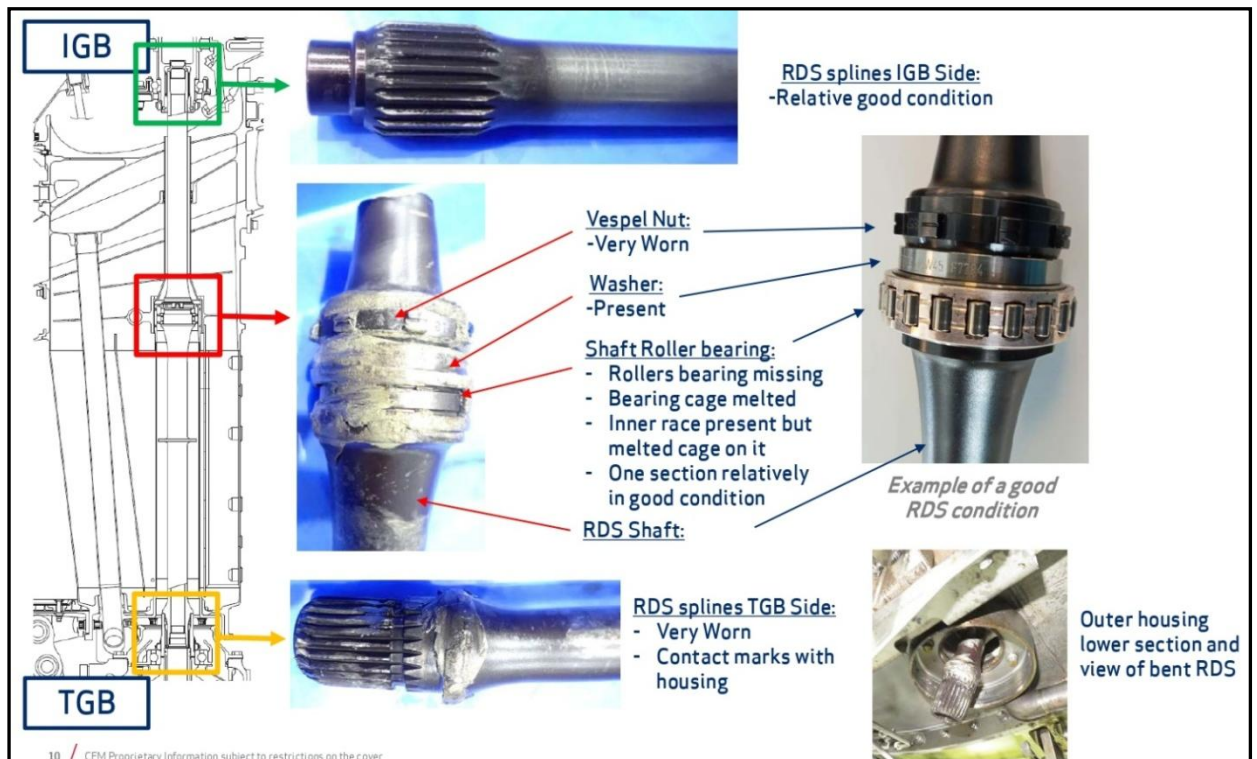


Figure 30: Inspection of RDS splines IGB and TGB side (Source: M/s CFM)

➤ TGB housing inspection / Adapter seal:

Inspection on the TGB housing / adapter seal reveals that the TGB adapter seal found cut, some bolts found loose and safety wire in the wrong direction.

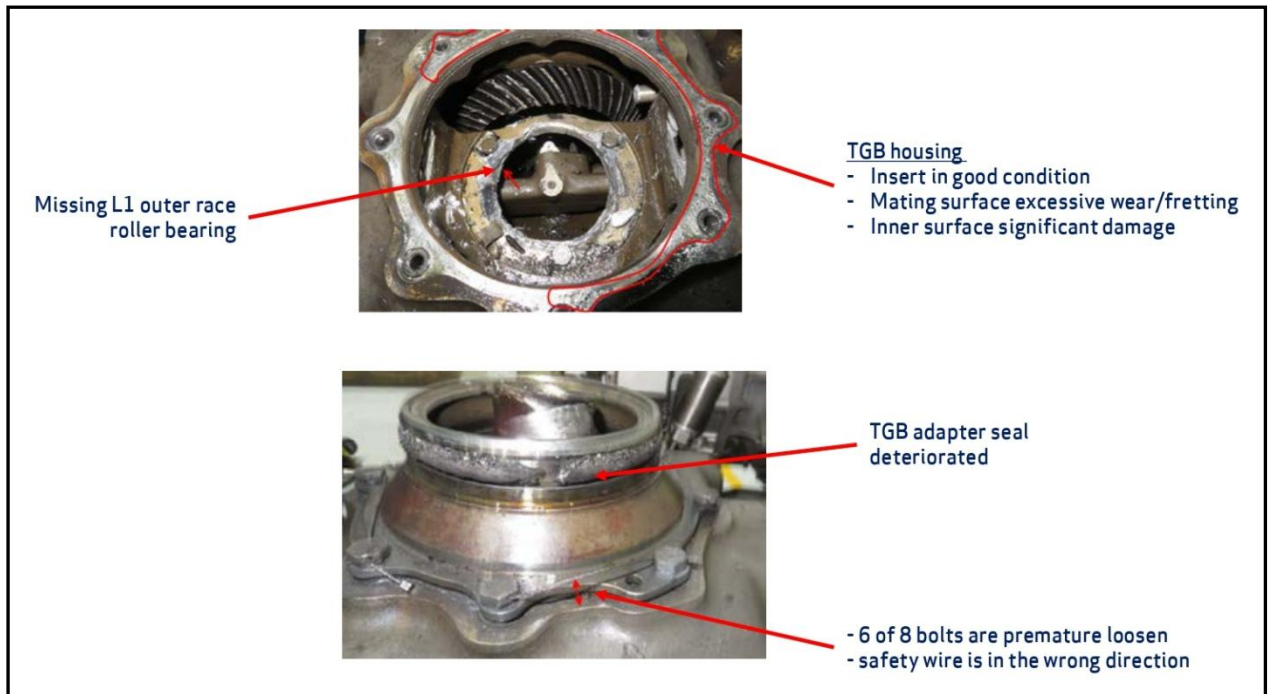


Figure 31: Inspection of TGB housing and adapter seal(Source: M/s CFM)

➤ TGB Line 1 (L1) and Line 2 (L2) Gear shafts Inspection:

Inspection on the TGB Line 1 (L1) and Line 2 (L2) Gear shafts reveals that the Line 1 input bevel gear 31-tooth worn severely, Ball Bearing L1 missing, Roller Bearing L1 outer race missing, rollers missing and TGB Line 2 horizontal bevel gear shaft 40-tooth with contact marks.

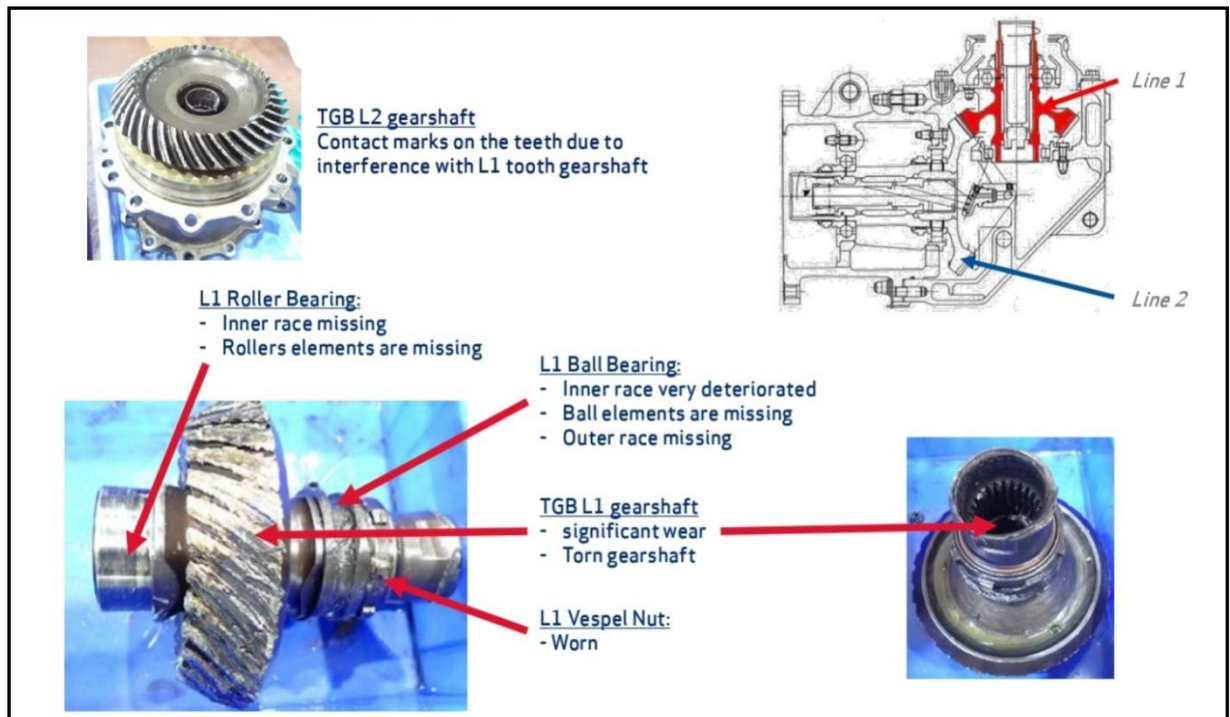


Figure 32: Inspection of TGB Gear shaft (Source: M/s CFM)

1.17 Organizational and Management Information:

M/s AIX Connect Private Ltd is a Scheduled operator, operating a fleet of Airbus A320-200 series aircraft. Air Operator Certificate number (AOC) is S-26 and was valid up to 06 May 2024.

1.18 Additional information:

1.18.1. The statement of the Flight crew of VT-VTZisas follows:

Flight Crew stated that at approximately 12:08 UTC while the aircraft was passing through 18000 ft, a bang noise emanated from the aircraft, resulted in a slight yaw to the left. Engine Warning Display (EWD) revealed a drop in N1 on engine#1 and shortly thereafter an ECAM AUTOFLT-AP OFF indication followed by ENG 1 FAIL appeared. Flight crew took actions to maintain control of the aircraft and made a PAN PAN call. Once the aircraft was stabilized, ECAM actions were initiated and completed in accordance with established procedures. Thereafter the aircraft made a single engine landing at Kolkata Airport safely. The aircraft was taxied to the designated bay and handed over to the engineering team for thorough inspection.

1.19 New investigation techniques: Nil

2. ANALYSIS:

2.1. Pilot handling of the Aircraft:

On 8th January 2024, M/s AIX Connect Pvt. Ltd., A320-214 Aircraft registration VT-VTZ, operating scheduled flight I5-1563 from Kolkata (VECC) to Bhubaneswar (VEBS) was involved in an incident of Engine In-flight shutdown during climb at Kolkata. Both the operating crew was duly qualified and current on type (A320) to operate the flight, medically fit, provided adequate rest and found to be within FDTL limits before they operated flight I5-1563 on the date of incident.

Before joining M/s. AIX connect as flight crew, the first officer had flown for other airlines till 29th April 2023. On the day of incident, he started his first SLF flight in AIX Connect after completing the necessary simulator training.

During climb while passing FL180, the flight crew heard a boom sound with the aircraft yawing slightly to the left. The flight crew observed a drop in N1 for engine#1 on the EWD (Engine Warning Display). Shortly thereafter, ECAM warning ‘AUTO FLT AP OFF’ followed by ‘ENG 1 FAIL’ was annunciated.

Analysis of the DFDR also revealed that, at 12:08:17 UTC while passing FL178, engine#1 N1 decreased abruptly from 89.13% to 67.88% and continued to decrease further. Subsequently, all other engine#1 parameters like N2, oil pressure, EGT, fuel flow decreased abruptly. Thereafter, after 8 sec (12:08:24 UTC) when the aircraft was at an altitude of 17980 ft, engine#1 master warning was recorded.

Immediately, PIC took control of the aircraft (corroborated from CVR) and declared “PAN-PAN” and followed the ECAM actions. The flight crew of I5-1563 apprised the situation to Kolkata ATC and informed that they are returning to Kolkata due to engine failure and requested for leveling off at FL180. The same was approved by the Kolkata ATC. After engine#1 power loss, the aircraft climbed till 18312 feet (at 12:09:40 UTC) before leveling off at FL180.

Upon completion of the ECAM procedures, the flight crew of I5-1563 made air turn back to Kolkata due to the proximity of the airport and known weather conditions.

Analysis of the CVR also revealed that the flight crew of I5-1563 followed the FCOM for abnormal and emergency procedure for Engine fail. To re-light the engine#1, crew selected engine mode for ignition and thrust lever of engine#1 to idle. Since, relight for engine#1 was unsuccessful, the flight crew moved the engine#1 master lever to OFF and completed in accordance with the established procedure.

Thereafter, after completing requisite checklists, the aircraft made ILS approach for RWY 01R at Kolkata and landed with single engine at 1229 UTC uneventfully. All the passengers on the aircraft were safe and there was no fire or smoke was reported.

From the above deliberations, it is inferred that the flight crew actions were in line with the standard operating procedures as per FCOM and is not a contributory factor to the incident.

2.2. Weather:

The prevailing weather at Kolkata was within approved minima of crew and aircraft. The reported visibility was 2400 meters, winds 340°/06 knots, QNH 1016, temperature 24°C and trend NOSIG. Runway surface condition was dry and there were no rain or turbulence. Metrological report did not show any significant change in trend of the prevailing weather.

From the above deliberations, it is inferred that the weather is not a contributory factor to the incident.

2.3. Engineering Aspect:

Aircraft VT-VTZ (MSN 4379) was manufactured in year 2010. The aircraft was registered with DGCA. At the time of incident; the Certificate of Airworthiness, Airworthiness Review Certificate and Certificate of Registration was current and valid.

This aircraft was operated under Scheduled Operator's Permit No S-26 which was valid up to 06.05.2024. The aircraft and its engines were being maintained as per the maintenance program approved by Regional Airworthiness office, Bangalore.

The last major inspection (C06 C-Check) was carried out at on 13-June 2023 at Hyderabad. Subsequently all lower inspections (Preflight checks, E021, E022 checks) were carried out as and when due before the incident.

All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modification on this aircraft and its engine have been complied with as & when due. Prior to the incident flight the weight and balance of the aircraft was well within the operating limits.

Before operating the flight from Kolkata, preflight inspections were carried out as per approved inspection schedules.

The aircraft VT-VTZ fitted with CFM56-5B engine and this engine has no periodic overhaul schedules and can remain installed under the wing until something important occurs, or when lifetime limits of parts are reached. These engines are continuously monitored by the OEM (M/sCFM) and Customer Notification Reports (CNR) will be issued with some recommendations to the customers based on the engine performance trend monitoring.

M/s AIX Connect Pvt Ltd received two CNR from M/sCFM dated 15/11/2023 and 04/01/2024 on engine serial number 699981 installed on VT-VTZ as engine position #1. In both the CNR, M/s. CFM conveyed that the engine had experienced a gradual decrease in overall HPC compression efficiency and recommends to perform the engine wash by using detergent based cleaning agent wash as per AMM task. Accordingly, detergent based water wash was carried out on engine #1 on 22/11/2023 for the first CNR and for the second CNR, work order has been raised on 05/01/2024 with the due date of 08/01/2024, however the task was not performed as the subject engine was involved in the incident of auto in-flight shut down on 08th January 2024. Power plant team of M/s. AIX Connect Pvt Ltd confirmed that there is nil engine parameters exceedance on the CFM portal monitoring since the issuance of

CNR (20240104050) on 04th January 2024 till the event flight. However, the subject CNR is not a contributory factor to the subject engine in-flight shutdown incident.

During climb while passing FL180, the flight crew observed a drop in N1 for engine#1 on the EWD (Engine Warning Display). Shortly thereafter, ECAM warning 'AUTO FLT AP OFF' followed by 'ENG 1 FAIL' was annunciated. Immediately, after followed the ECAM action, the flight crew made air turn back to Kolkata and landed safely. During the troubleshooting, Master Chip Detector (MCD) inspection was carried out and metal particles were found. The metal particles were not sent to the laboratory for investigation. Oil was also seen seeping through the ventilation hole in the No.7 Strut, however as per M/s. Airbus and M/s. CFM experience, the oil leak in addition to the No.7 Strut deformation is due to RDS bearing failure.

Based on the shop finding made by the M/s. MTU maintenance, M/s. CFM made an event analysis and identified that the event of IFSD exhibited heavy parts worn out & missing parts on both TGB and RDS. Inspection on the TGB housing / adapter seal reveals that the TGB adapter seal found cut, some bolts found loose and safety wire in the wrong direction.

As per M/s. CFM, heavy parts worn out & missing parts makes the identification of the root cause difficult, however lower section of the bent RDS suspects that a deterioration in the TGB could have caused the deformation of the RDS and then RDS to fail.

Suspected root cause of the TGB deterioration is the result of the failure of TGB L1 roller bearing. Root cause of the TGB L1 roller bearing failure could not be identified due to missing parts (bearing roller elements, races, ball bearing and heavy wear on TGB parts). Further, M/s. CFM concludes that the most probable scenario for the IFSD is in sequence of L1 roller bearing failure, L1 ball bearing failure, L1 and RDS orbiting, L1 gear shaft wear and then RDS destruction by a RDS blockage in the TGB Housing has led to engine shutdown.

DFDR analysis indicate the parameters (N2, N1, Fuel Flow, oil pressure) decreased suddenly in few seconds, which is coherent with RDS housing, RDS and TGB findings observed during inspections by M/s. CFM. The engine 1 auto shut down occurred after 8 seconds of all parameters suddenly decreased (N2 came under 50%).

From the above deliberation, it is inferred that the deterioration and blockage in the TGB could have caused the deformation of the RDS which led to the Engine In-flight shutdown.

3. **CONCLUSION:**

3.1. Findings:

- 3.1.1. The Certificate of Airworthiness and the Certificate of Registration of the aircraft was valid on the date of incident.
- 3.1.2. The flight crew members were appropriately licensed and qualified to operate the flight.
- 3.1.3. All the concerned Airworthiness Directive, Service Bulletins, Mandatory Modifications on this aircraft and its engines were found complied with.
- 3.1.4. The engine OEM had issued CNR dated 14 November 2023 for engine#1 and recommended engine wash, which was carried out on 22 November 2023. CNR for this engine was again issued on 4 January 2024 reporting decrease in overall HPC compressor efficiency and recommended engine wash. Work order was raised on 5th January 2024 and was due on 8 January 2024.
- 3.1.5. NIL engine parameter exceedance was noted on CFM portal since the issue of CNR on 4th January 2024 till the incident flight. OEM had advised engine wash, which was valid for duration of 30 days of issuance of CNR.
- 3.1.6. The aircraft was released from Kolkata in a serviceable condition, for a scheduled revenue passenger flight. There was no similar snag/defect reported prior to the incident sector.
- 3.1.7. Both the cockpit crew had undergone pre-flight medical examination prior to flight and same was negative.
- 3.1.8. After takeoff from Kolkata while climbing passing through FL180, a loud boom sound was heard by the flight crew with the aircraft yawing slightly to the left.
- 3.1.9. The flight crew observed ECAM warning 'AUTO FLT AP OFF' followed by 'ENG 1 FAIL' was annunciated followed by un-commanded engine shutdown.
- 3.1.10. The crew declared "PAN-PAN" and followed the ECAM actions and made air turn back to Kolkata due to the proximity of the airport and known weather conditions.
- 3.1.11. The aircraft made a safe single engine landing at Kolkata and taxied on its own power to the parking bay. There was no injury to any of the occupants onboard the aircraft and there was no fire and no external damage to the aircraft.
- 3.1.12. Crew actions were appropriate and in compliance of the FCOM procedure/checklists.
- 3.1.13. During the troubleshooting, Master Chip Detector (MCD) inspection was carried out and metal particles were found. The metal particles were not sent to the laboratory for investigation.

- 3.1.14. During Shop Inspection on the TGB housing reveals that the TGB adapter seal found cut, some bolts found loose and safety wire in the wrong direction.
- 3.1.15. M/s. CFM made an analysis and identified that the event of IFSD exhibited heavy parts worn out & missing on both TGB and RDS.
- 3.1.16. As per the M/s.CFM, heavy parts worn out & missing makes the identification of the root cause to be difficult. However, lower section of the bent RDS suspects that a blockage in the TGB could have caused the deformation of the RDS.
- 3.1.17. Suspected root cause of the TGB deterioration is the result of the TGB L1 roller bearing failure.However root cause of failure of TGB L1 roller bearing could not be identified due to missing parts like bearing roller elements, races, ball bearings etc.
- 3.1.18. DFDR analysis indicate the parameters (N2, N1, Fuel Flow, oil pressure) decreased suddenly in few seconds, which is coherent with RDS housing, RDS and TGB findings observed during inspections by M/s.CFM.
- 3.1.19. Weather was not a contributory factor to the Incident.

3.2. Probable Causes of the Incident:

3.2.1. The probable cause of the incident is the deterioration and blockage in the Transfer Gear Box due failure of TGB L1 roller bearing, could have caused the deformation of the Radial Drive Shaft, which led to the In-flight engine shutdown. The reason for failure of TGB L1 bearing could not be ascertained due to missing bearing parts.

4. SAFETY RECOMMENDATION :

Action, as deemed fit may be taken by the DGCA-HQ in view of the above findings.



Abhijeet Banerjee

Asst. Director of Air Safety
Member



Sudhan Uthirapathy

Asst. Director of Air Safety
Investigator-In-Charge

Date: 15.07.2025

Place: Kolkata/Chennai

CVR Transcript of I5-1563:

CVR Relative time	From	Conversation
1:16:21	Capt	I have controls (AP disconnect Chime)
1:16:26	FO	Engine Thrust MCT
	Capt	Call PAN PANPAN
1:16:37	FO	PAN PANPAN, Eng 1 Fail Standby
1:16:43	Capt	ECAM Actions
1:16:47	FO	Auto Flt AP off, Eng 1 Fail, Eng Mode selector- Ign
1:16:51	Capt	Kolkata, RK 1563, Engine failure returning back to Kol, levelling off at FL 180
1:16:58	ATC	Confirm Engine Failure sir
1:17:01	Capt	Affirm sir, RK1563
	ATC	Roger turn right hdg 360
1:17:06	Capt	Hdg 360, RK 1563
	ATC	Confirm requesting full emergency
1:17:10	Capt	Negative sir, PAN PAN RK 1563
	ATC	Turn right Hdg 360
	Capt	Rt Hdg 360 RK 1563
1:17:20	ATC	Requesting priority landing sir
1:17:23	Capt	Affirm sir, call you when ready
	Capt	Thrust lever 1 idle
	Capt	Request level off FL 180
1:17:36	ATC	Roger stop climb at FL 180
	Capt	RK 1563 set FL 180
	FO	FL 180 set
	Capt	Pull
1:17:54	FO	Thrust Idle
	FO	Thrust lever 1 idle
	Capt	Chk, Level off
1:18:06	Capt	Activate secondary
1:18:15	FO	Capt Flt plan is for....
1:18:20	Capt	Request descent RK 1563, Set for Kolkatta
1:18:31	Capt	Req Descent RK 1563
1:18:32	ATC	RK 1563 descend to FL 90
1:18:37	Capt	Desc FL 90 RK 1563, Thrust Idle Open descent FL 90 blue
1:19:00	SCC	Capt [REDACTED] from D1 L
	Capt	We have had an eng fail, returning to Kol, Prepare cabin
	SCC	Ok
1:19:20	ATC	RK 1563 when able let us know nature of Emergency
1:19:26	Capt	Sir we had Engine, coming back to Kol for ldg, will call you when ready for the approach
	ATC	Roger

	FO	Activate secondary Capt
	Capt	Activate
1:19:45	Capt	Continue ECAM
	FO	Thrust lever No 1 Idle
	Capt	Thrust lever No. 1 , Confirmed
	FO	Capt we dont seem to have engine damage
1:20:11	Capt	Open Eng relight chk list
1:20:30	FO	Eng relight
	FO	Engine master affected engine off
	Capt	Engine master affected engine off
	FO	Thrust lever engine 1 Idle
	Capt	Idle
	FO	Ign mode selector
	Capt	Ignition
1:21:00	Capt	X Bleed open
	Capt	Open
	FO	Wing Anti Ice for starter assist, theres no wing anti ice
	FO	Eng Master affected engine on
	Capt	On
1:21:15	ATC	RK 1563 turn right Hdg 200
	Capt	Turn Rt hdg 200 RK 1563
	ATC	Vectoring for ILS app 01 R
	Capt	RK 1563
1:21:35	Capt	Continue ECAM
	FO	Engine master affected Off
	FO	Engine parameter, N2, EGT monitor Relight should be achieved in 30 sec
	Capt	Check
1:21:50	ATC	RK 1563 report your endurance
	Capt	Stand by RK 1563, No relight continue
1:22:15	FO	If No relight, eng master affected eng off, Confirm
	Capt	Confirmed
1:22:30	FO	Eng 1 Shut down, Fuel imbalance, TCAS to TA, Clear Eng 1
	Capt	Clear eng 1
	FO	Land ASAP amber
	Capt	Check
1:22:40	FO	Bleed: we have bleed from eng No. 2
	Capt	Check
	FO	Elec: we have Gen 2 supplying Gen 1
	Capt	Start APU
1:23:12	ATC	RK 1563 priority landing is approved
	Capt	Copied sir call you when ready RK 1563
	ATC	Descend level 60
	Capt	Descend level 60, RK 1563, VS -500, FL 60 blue
	FO	Clear Elec
	Capt	Clear Elec

1:23:32	FO	Hyd: PTU supplying from yellow, Clear Hyd
	Capt	Clear Hyd
	ATC	Contact App RDR 127.9
	Capt	Stop ECAM, Normal Chk list, Any OEB, Comp reset, Continue ECAM
	FO	Status One Pack only, wing anti ice on, Cat III single only, Inop syst- Cat III dual
	ATC	RK 1563 report when you are ready for approach and report endurance when ready
	Capt	Copied sir RK 1563
	Capt	Continue ECAM
	FO	Inop syst, Cat 3 Dual, Eng 1 Bleed, Main Galley, Gen 1, Green Eng 1 pump, Remove status
	FO	APU available
1:24:27	Capt	Request for latest weather
	ATC	RK 1563 turn left 120
	Capt	turn left 120 RK 1563
	FO	Rdr request latest weather for RK 1563
1:24:57	ATC	Latest WxKolkata, Time of Ob 1200, wind 340/06, Vis 2400 Hz, NSC, temp 21/26, QNH 1016
	FO	Copied sir RK 1563
	ATC	Turn left 100
	Capt	Turn left 100
	ATC	Confirm ready for further descent
1:25:44	Capt	Negative, Ok quick CLEAR model, we have lost Eng 1, relight was not successful. We approached Kol, Overwtdg NA, we are going back for approach. Evaluate: Engis safe, no damage. we have completed ECAM, we will do a quick ldgdist calculation. Thereafter we will review our actions with SFLE and continue the approach.
	Capt	Do the ldgdist calculations RW 01 R
	Capt	Request further descent
	ATC	2000 ft TL 50 QNH 1016
	ATC	Turn left 060
1:27:00	FO	Captain Vapp is 141, FLD is 2074, LD is 1803, Margin is 1559
	Capt	Ready for control, Thrust Idle Open Desc, Hdg FL 20, you have controls
	FO	I have controls
	Capt	Dont touch anything, OK quick briefing, Vectors for ILS 01 R Chart 11-1, 13 Mar 23, 109.9, Final App course 007, Height check.....
1:28:10	ATC	RK 1563, Radar
	Capt	Can You inform us the Endurance
1:28:25	Capt	PAPI on the left, after landing will vacate conveniently Terrain not a threat, weather not a threat, CONFIG 3 Auto brake low, overweight landing NA, Fuel we have 4....
	ATC	Advise when ready for Approach 01R
	Capt	wilco, if no question briefing is complete. OK ill just inform everybody. CC for TEST bfg, Set QNH 1016

	FO	Passing 4900
	Capt	No Deviation
1:29:20	Capt	Hi [REDACTED], we have lost ENG 1 going in for landing, we have about 10 mins or so, Normal landing, No evacuation, we will go back normally
	ATC	RK 1563, turn right Heading 360
	Capt	If anything changes, I will let You know, secure the Cabin, sit down and I will give you landing clearance in some time. Can you repeat
	SCC	Repeats Bfg
1:29:59	Capt	Ill make a short PA now
1:30:20	Capt	Makes PA
1:30:32	ATC	RK 1563 turn left hdg 280
	FO	Turn left hdg 280 RK 1563
	Capt	Ok i have controls, approach checklist
1:31:00	FO	Reads Approach Chk List
	Capt	Rad Alt Alive, Overwtdgchk list NA, Straight in One Enginopchklist , Give me flaps
	ATC	How many track miles do you require
	Capt	Comfortable on trk miles, will be ready for app in 2 min
1:32:16	FO	One enginopchklist, If no level off.....
	ATC	Continue present hdg, vectors for ILS app 01 R
	ATC	You are approx 12 miles from TD
	FO	If no level off is expected during finals delay conf full untill established on Final app, If level.....
	Capt	Flaps Slats jammed NA, LdgChk list pending. Tell him ready for the approach
	FO	Ready for the app RK 1563
1:33:05	ATC	RK 1563 Turn right 340 cleared ILS 01 R call established on Loc
1:33:10	FO	Turn right 340 cleared ILS 01 R call established on Loc, RK 1563
	Capt	Ok be with me, see anything wrong call it out
1:33:30	Capt	GS Blue Loc Blue, Cat 3 Single, AP 1+2
	FO	Checked
	Capt	Loc *
	FO	Established on Loc
	ATC	Roger contact Twr 118.1
1:34:20	FO	Twr, RK 1563
	ATC	RW 01 R 350/06, cleared to land
	Capt	GS * Go around at 2000 Ft set, Gear down, Advise crew, Flap 3
	FO	Speed chk Flap 3
1:35:18	Capt	Ldg Checklist
	FO	ECAM Memo- Ldg No Blue, Cabin-Ready
	Capt	All Chk lists complete
1:36:18	Capt	1000 Stabalised
1:36:55	Capt	Mantain the AP as long as possible
	FO	OK Capt
	Capt	Land

1:37:18	Capt	Minimum Continue, disengaging AP, 50 ft give me rudder trim to neutral
1:37:32	Capt	Rudder trim 0
1:37:38		Touch down
	FO	Spoilers, Rev green, Decel, 70 Kts
	ATC	RK 1563 if able vacate via Q1,A,Q2
	FO	if able vacate via Q1,A,Q2, RK 1563
	ATC	Q1, turn right on RW 01L
	FO	Q1, turn right on RW 01L, RK 1563
	ATC	Contact ground 121.9
	FO	Contact ground 121.9, RK 1563
	Capt	Q1 thereafter reconfirm
	ATC	Right on RW 01 L
	Capt	TCAS to off
	ATC	RK 1563, confirm you require emergency services
1:39:17	Capt	Negative
	ATC	Taxi 01 L, N, N2, F , F1, Bay 22
	FO	Taxi 01 L, N, N2, F , F1, Bay 22, RK 1563