



**FINAL INVESTIGATION REPORT ON
AIR TURN BACK INCIDENT DUE TO BIRD STRIKE TO
M/s GO AIRLINES (INDIA) LTD AIRBUS A320-214 AIRCRAFT
VT-GOS ON 21/06/2017 AT DELHI**

**GOVERNMENT OF INDIA
O/o, DIRECTOR AIR SAFETY, WESTERN REGION,
NEW INTEGRATED OPERATIONAL OFFICE COMPLEX,
SAHAR ROAD, VILE PARLE (EAST), MUMBAI-400099**

OBJECTIVE

This investigation is performed in accordance with The Aircraft (Investigation of Accidents and Incidents) Rules 2012 of India.

The sole objective of this investigation is to prevent aircraft accidents and incidents. It is not the purpose of this investigation to apportion blame or liability.

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ABBREVIATIONS

A/c	Aircraft
ADF	Automatic Direction Finder
AEMC	Aerodrome Environment Management Committee
Aircraft	Incident aircraft
AOP	Air Operator Permit
APU	Auxiliary Power Unit
ARC	Airworthiness Review Certificate
ASDA	Accelerate Stop Distance Available
ATC	Air Traffic Control
ATPL	Air Transport Pilot's License
CPL	Commercial Pilot's License
CRM	Cockpit Resource Management
CSN	Cycles Since New
CVR	Cockpit Voice Recorder
DIAL	Delhi International Airport Limited
DME	Distance Measuring Equipment
DVOR	Doppler Very high frequency Omni Range
ECAM	Electronic Centralised Aircraft Monitor
EMCD	Electrical Master Chip Detector
ENG	Engine
FAA	Federal Aviation Administration, United States of America
FADEC	Full Authority Digital Engine Control

FATA	Foreign Aircrew Temporary Authorisation
FCOM	Flight Crew Operating Manual
FCTM	Flight Crew Training Manual
FDR	Flight Data Recorder
FDTL	Flight and Duty Time Limitations
FLX-MCT	Flex- Maximum Continuous Thrust (thrust setting)
FM	Follow Me vehicle
FOD	Foreign Object Damage
FO	Co-Pilot/ First Officer
FRTO	Flight Radio Telephone Operator
GPS	Global Positioning System
Ground	Surface Movement Control
IAS	Indicated Air Speed
IATA	International Air Traffic Association
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
IGI Airport	Indira Gandhi International Airport
ILS	Instrument Landing System
IR	Instrument Rating
LDA	Landing Distance Available
LDG	Landing
LHS	Left Hand Side
MEL	Minimum Equipment List

MMCD	Master Magnetic Chip Detector
NDB	Non-Directional Beacon
Operator	AOP holder of the incident aircraft
PA system	Passenger Address system
PDR	Pilot Defect Report
PIC	Pilot in Command
QNH	Pressure Setting to Indicate Elevation
QRH	Quick Reference Handbook
RA	Radio Altitude
RADAR	Radio Detection and Ranging
RHS	Right Hand Side
SCT	Scattered
SOD	Staff on Duty (Additional Crew Member)
SOP	Standard Operating Procedure
TO/GA	Take-off/ Go-around- thrust lever position
TODA	Take-off Distance Available
TORA	Take-off Run Available
Tower	Air Traffic Control tower
TSM	Troubleshooting Manual
TSN	Time Since New
UTC	Coordinated Universal Time
VFR	Visual Flight Rules
VOR	Very high frequency Omni Range
WHM	Wildlife Hazard Management

FINAL INVESTIGATION REPORT OF INCIDENT TO
M/s GO AIRLINES (INDIA) LTD AIRBUS A320-214 AIRCRAFT
VT-GOS ON 21/06/2017 AT DELHI

1.	Aircraft Type	Airbus A320-214
2.	Nationality	Indian
3.	Registration	VT-GOS
4.	Owner	M/s New Skye Leasing Dac Pinnacle, 2 Eastpoint Business Park Clontarf, Dublin 3, Ireland
5.	Operator	M/s Go Airlines (India) Ltd
6.	Pilot In- Command	Airline Transport Pilot's License Holder
7.	Extent of Injuries	Nil
8.	Date and Time of Incident	21/06/2017 05:58 hrs
9.	Place of Incident	Delhi
10.	Geographical location of site of Occurrence (Lat. Long.)	28°34'12.2"N, 77°06'33.8"E
11.	Last point of Departure	Delhi
12.	Intended Place of Landing	Mumbai
13.	No. of Passengers On-Board	156
14.	Type of Operation	Schedule, Passenger
15.	Phase of Operation	Take-off Roll
16.	Type of Incident	Wild Life Strike

All timings in this report are in UTC.

SYNOPSIS:

On 21st June 2017, M/s Go Airlines (India) Ltd Airbus A320-214 aircraft VT-GOS was involved in Air Turn Back incident due to Bird Strike while operating flight G8 - 338 (Delhi- Mumbai).

During take-off roll on Runway 09 at around 115 knots IAS, aircraft encountered bird strike on Engine # 2. Both crew noticed abnormal sound and vibrations but PIC decided to continue for take-off probably wanting to investigate the problem after getting airborne. After take-off the situation was incorrectly assessed and the Engine # 1 (unaffected engine) was shut down. Aircraft was climbing with the single engine, i.e. Engine # 2 (affected engine), for over three minutes. Aircraft stopped climbing at around 3330 ft altitude. Crew realized their mistake and attempted to start Engine # 1 but encountered Start Valve Fault. Crew carried out appropriate actions and Engine # 1 was started at an altitude of around 3100 ft. Power from Engine # 1 was found to be available at an altitude of 3108 ft. The throttle of the Engine # 2 was later reduced as per QRH procedure and put on to IDLE. Probably aircraft lost considerable amount of energy in the process of starting Engine # 1 which, combined with flying the aircraft in absence of autopilot due to weather, resulted in activation of ALPHA FLOOR. Crew carried out appropriate action and ALPHA FLOOR was de-activated after 28 seconds at 2600 ft altitude. Crew requested to ATC for go around in first approach as the aircraft was too high on a glide. Subsequently, in second approach, aircraft landed uneventfully at Delhi on single engine, i.e. Engine # 1. The vibration value of N1 of Engine # 2 was above the specified limits for approximately six minutes during the flight.

On arrival, during physical inspection, the blood stains were observed spread on the acoustic panel of Engine # 2 & damage was observed on the tips of the leading edge of two fan blades, i.e. blade # 21 & # 22. After rectification, the aircraft was released to service on 21/06/2017.

The incident occurred in day time when the reported visibility was 2500 meter. No human injury was reported in the incident.

Director General of Civil Aviation ordered the investigation of the incident by appointing Inquiry Officer vide order no. AV.15023/4/2017-AS dated 22nd June 2017 under Rule 13(1) of The Aircraft (Investigation of Accidents and Incidents) Rules 2012. Incident was caused by incorrect identification of engine affected with high vibration followed by non-adherence to recommended procedures, lack of situational awareness, poor Cockpit Resource Management and poor handling of aircraft during emergency subsequent to bird strike.

1. FACTUAL INFORMATION:

1.1 History of Flight:

M/s Go Airlines (India) Ltd Airbus A320-214 aircraft, VT-GOS, was scheduled to operate flight no. G8 - 338 (sector Delhi – Mumbai) on 21st June 2017 at 05:15 hrs with 164 persons on-board including 06 crew members and 02 Staff on Duty. The aircraft was under the command of PIC (ATPL holder). PIC was the pilot flying and First Officer was pilot monitoring. The aircraft taxied out at 05:33:20 hrs without any relevant snag and got airborne at 05:40:44 hrs from Runway 09.

Crew completed 'Before Take-off Checks' and the take-off clearance was granted by ATC at 05:39:53 hrs.

During take-off roll, crew experienced abnormal sound & vibrations. Being unsure of the reason for vibrations, First Officer enquired PIC for rejecting take-off but PIC decided to continue for take-off as he was not sure that the aircraft would stop within the available runway, if executed rejected take-off, and probably wanting to investigate the problem after getting airborne. ECAM advisory for high N1 vibration of Engine # 2 came at 05:40:32 hrs as value of N1 vibration of Engine # 2 reached above specified limit, i.e. ≥ 6 . The vibration advisory was not called out by First Officer. Aircraft IAS was 129 knots at this stage. Values of V_1 , V_R & V_2 were calculated to be 146 knots, 146 knots and 147 knots respectively.

After getting airborne, cockpit crew noticed the problem of high engine vibration but assessed the situation incorrectly. As a result, they shut down the Engine # 1 (unaffected engine) by putting its MASTER- OFF at 05:41:48 hrs and increased power to TO/GA on the Engine # 2 (affected engine).

Crew declared emergency due to engine problem to ATC, Delhi at 05:41:50 hrs and requested immediate turn back to Delhi for landing, which was granted by ATC.

During subsequent conversations while climbing, wherein PIC inquired about the engine vibrations, First Officer repeatedly prompted PIC about Engine # 1 vibration out of limits.

The aircraft was climbing on affected engine's power varying from TO/GA to CLIMB while the unaffected engine was shutdown. On directions from ATC, aircraft stopped climbing at 05:43:13 hrs at around 3330 ft altitude. Subsequently, PIC recognized that the Engine # 2 is affected with high vibrations. Crew realized their mistake at 05:43:42 hrs about shutting down the wrong engine and decided to switch on the unaffected engine.

Crew put MASTER-ON of the unaffected engine at 05:43:49 hrs and attempted to start the engine. While attempting the start of Engine # 1, the Engine # 2 power was put on IDLE at 05:44:15 hrs. At this stage, aircraft was flying at an altitude of around 3332 ft with only affected engine running on IDLE. The attempt to start Engine # 1 resulted in 'Start Valve Fault' at 05:44:57 hrs. Crew took appropriate action to rectify the same. Engine # 2 power was put on CLIMB again from 05:45:42 hrs up to 05:45:59 hrs.

First Officer confirmed at 05:45:58 hrs that Engine # 1 is available. Engine # 2 was put to IDLE at 05:46:00 hrs and Engine # 1 put to CLIMB on 05:46:01 hrs. Aircraft was at 3024 ft altitude at this stage.

As per the occurrence report, the weather, after take-off, was very turbulent and the autopilot was not holding. Autopilot was disengaged at 05:41:50 hrs and several times from 05:45:43 hrs to 05:46:44 hrs.

In the process of starting Engine # 1, aircraft lost considerable amount of energy which probably combined with manual handling of aircraft, immediately resulted in activation of protective ALPHA FLOOR at 05:46:01 hrs which lasted for 28 seconds. Crew carried out appropriate action and ALPHA FLOOR got deactivated at 05:46:29 hrs at 2600 ft altitude. ECAM advisory for high N1 vibration of Engine # 2 went off at 05:46:37 hrs.

Value of N1 vibration of Engine # 2 was above the specified limits (≥ 6) for approximately six minutes. The maximum value of N1 vibration of Engine # 2 recorded was 9.9.

While in approach for the landing at 05:50:57 hrs, crew requested ATC for Go-around as they were too high on a glide. The same was granted by ATC immediately. Crew initiated Go-around at approximately 05:51:07 hrs with Engine # 1 on FLX-MCT and Engine # 2 on IDLE.

In the second approach, aircraft landed uneventfully on Runway 10 at Delhi at 05:58:36 hrs with Engine # 2 on IDLE. No injury to any person was reported in the incident.

While taxiing to the allocated stand for parking, not realizing their position with respect to parking stand, crew took wrong turn. Crew of Follow Me # 8 realized the same and communicated to Surface Movement Control (Ground) to ask aircraft to hold the position and switch off the engines. Aircraft held its position and switched off both the engines at 06:01:40 hrs. Subsequently, aircraft was towed to reposition it correctly on the allotted parking stand.

On arrival, during physical inspection, the blood stains were observed spread on the acoustic panel of Engine # 2 & damage was observed on the tips of the leading edge of two fan blades i.e. blade # 21 & # 22.

As crew were unaware about the Bird Strike, no information was given to ATC, Delhi for the same during the incident flight. Identification of species of struck bird could not be carried out as only blood stains were observed on acoustic panel of Engine # 2.

Aircraft's take-off weight was 65,700 kg and landing weight was 64,770 kg, which was above Maximum Landing Weight, i.e. 64,500 kg.

After the incident, both crew operated Airbus A 320 aircraft VT-WAF for the same flight G8 – 338 (Delhi – Mumbai).

1.2 Injuries to Persons:

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor	0	0	0
None	6	156+2*	

* SOD

1.3 Damage to Aircraft:

Tips of the leading edge of two fan blades no. 21 & 22 were damaged. Both the blades were distorted shingled.



Figure # 1
Damage to Blade no. 21 & 22



Figure # 2
Damage to Blade no. 21 & 22

1.4 Other Damage: None.

1.5 Personnel Information:

Pilot- In-Command:

Age	64 years 09 months Male
License	ATPL
Date of Issue	18/04/1988
Valid up to	24/02/2021
Category	Aeroplane
Date of Class I Medical Exam	29/03/2017
Class I Medical Valid up to	28/09/2017
Date of Issue of FRTTO Licence	12/11/1974
IR rating and Instructor rating	IR: 08/05/2017, Instructor rating: Nil
FRTTO Licence Valid up to	17/05/2022
Total Flying Experience	23507:51 hrs
Total Flying Experience on Type	13187:47 hrs
Total Flying Experience in last 1 year	226:17 hrs
Total Flying Experience in last 6 months	69:15 hrs
Total Flying Experience in last 30 days	69:15 hrs
Total Flying Experience in last 7 days	18:23 hrs
Total Flying Experience in last 24 hours	03:45 hrs
Duty Time last 24 hours	Nil
Rest before the incident flight	01 day before 21/06/2017
Ratings	As PIC: Airbus 300/ 319/ 320/ 321, Boeing 737, HS 748, Pushpak As FO: Airbus 300/ 320, Boeing 737, HS 748

As per the records, PIC was approved as check pilot on Airbus 320 type of aircraft vide DGCA letter no. AV-22012/4/05-FID (Pt-II) dated 04/09/2006 and AV.22012/GA/1421/2010-FSD dated 08/02/2011. He was declared ‘Temporarily Medically Unfit for Flying’ several times from February 2014 till March 2017 during his Class- I medical assessment. However, he was also declared ‘Fit to Fly as Co-Pilot only’ on several occasions during this period (from February 2014 to March 2017) by Medical Examiner during his Class- I medical assessment.

He was declared fit to fly as PIC along with a ‘Qualified Experienced Pilot only’ in April 2017 during his Class- I medical assessment. He resumed flying as FO from 25/05/2017 to 14/06/2017 and as PIC from 16/06/2017.

He was examined for consumption of alcohol at Bangalore at 23:32 hrs on 20/06/2017 before carrying out Bangalore - Mumbai sector (flight no. G8 - 418) and found fit for flying.

PIC was having adequate rest before he operated flight on 21st June 2017. Upon scrutiny of the records, PIC was found to be within limits of FDTL.

Previous Incident History: PIC does not have any past incident history with the operator.

First Officer:

Age	30 years 02 months Male
License	CPL
Date of Issue	13/12/2013
Valid up to	12/12/2018
Category	Aeroplane
Date of Class I Medical Exam	12/08/2016
Class I Medical Valid up to	30/08/2017
Date of Issue of FRTO Licence	13/12/2013
IR rating and Instructor rating	IR: 08/01/2017, Instructor rating: Nil
FRTO Licence Valid up to	12/12/2018
Total Flying Experience	936:45 hrs

Total Flying Experience on Type	730:55 hrs
Total Flying Experience in last 1 year	636:37 hrs
Total Flying Experience in last 6 months	309:19 hrs
Total Flying Experience in last 30 days	54:35 hrs
Total Flying Experience in last 7 days	09:00 hrs
Total Flying Experience in last 24 hours	03:44 hrs
Duty Time last 24 hours	Nil
Rest before the incident flight	03 days before 21/06/2017
Ratings	As PIC: Beech Baron G 58, Cessna 172R As FO: Airbus 320

He was examined for consumption of alcohol at Bangalore at 23:18 hrs on 20/06/2017 before carrying out Bangalore - Mumbai sector (flight no. G8 - 418) and found fit for flying.

As per records available, First Officer was a qualified experienced pilot.

First Officer was having adequate rest before he operated flight on 21st June 2017. Upon scrutiny of the records, First Officer was found to be within limits of FDTL.

Previous Incident History with the operator:

First Officer was involved in ground incident on 29th June 2016 at Delhi, wherein LHS wing of Airbus 320 aircraft VT-GOL hit the Passenger Step Ladder whilst parking in the bay resulting in slat damage. He was operating the incident flight as First Officer. As per the investigation report of the operator, it was found that PIC failed to ensure wing-tip clearance on the Left Hand Side and as a consequence, hit the stationary passenger step ladder. It was also found that there was loss of situational awareness of operating crew and non-adherence to basic airmanship during taxiing. Both involved crew were subjected to CRM course, Ground course on interpretation of marshalling signals and route checks.

1.6 Aircraft Information:

The details provided below are as on prior to incident flight.

Aircraft Registration	VT-GOS
Type of Aircraft	Airbus A320-214
Aircraft Serial No.	3972
State of Manufacturing	France
Manufacturing year	2009
Owner	M/S New Skye Leasing Dac Pinnacle, 2 Eastpoint Business Park Clontarf, Dublin 3, Ireland
Operator	M/S Go Airlines (India) Ltd
Certificate of Airworthiness number and issue date	6836 dated 10/03/2017
ARC number and Validity	4-02/2017-AI (1)/ARC/6836 Valid up to 10/03/2018
A/c TSN / CSN	27589: 56 hrs / 17563
Maximum All Up Weight authorized	70,000 kg
Minimum crew necessary	Two
Engine Type	# 1 (LHS): CFM56-5B # 2 (RHS): CFM56-5B
Engine Sl no.	# 1 (LHS): 699466 # 2 (RHS): 699462
Engine Time since Last Shop Visit	# 1 (LHS): Not visited shop # 2 (RHS): 1137:56 hrs
Last major check (1A Check) carried out	06/05/2017 at 27061:01 hrs A/c TSN/ 17204 A/c CSN
Next schedule maintenance due at (2A Check)	06/09/2017 or 27811:01 hrs A/c TSN or 17954 A/c CSN whichever earlier

Failed part/ component in flight	Nil
Aircraft Take-off Weight	65,700 kg
Aircraft Landing Weight	64,770 kg
Maximum Landing Weight	64,500 kg
Fuel On-board before Flight	9,000 kg

1A check was carried out on aircraft on 06/05/2017 at 27061:01 hrs A/c TSN/ 17204 A/c CSN. Engine # 2 was released from FAA approved shop facility at 'GE Celma LTDA, Brasil' after repairs on 30/10/2016 at 25579 hrs Engine TSN/16157 Engine CSN and completed 1137:56 hrs/ 747 cycles since its fitment after shop visit prior to incident flight.

After completion of Daily Inspection schedule and Pre-departure schedule aircraft was released to service on 20/06/2017 at 23:50 hrs at Bangalore for the Bangalore - Mumbai sector (flight no. G8 - 418). The Scheduled Departure Time of the flight G8 - 418 was 00:15 hrs on 21/06/2017 and the aircraft departed at 00:17 hrs on 21/06/2017. Scrutiny of the maintenance records reveals that there was no relevant snag open for rectification and there was no active MEL invoked with regard to relevant aircraft systems while releasing the aircraft from Bangalore.

Before the incident flight, aircraft operated for Bangalore - Mumbai (flight no. G8- 418) and Mumbai - Delhi (flight no. G8- 327) sectors by the same set of crew with nil snags.

Before departure of the incident flight, aircraft was subjected to transit inspection. Aircraft take-off weight as per the Load & Trim sheet was 65,397 kg and fuel on-board before departure was 9,000 kg. However, as per FDR, aircraft take-off weight was 65,700 kg and fuel on-board before departure was 9,115 kg. As per the Load & Trim sheet, the Centre of Gravity was within limits.

Aircraft was airworthy before the incident flight.

As per Bug card, values of V_1 , V_R & V_2 were calculated to be 146 knots, 146 knots and 147 knots respectively.

Pilot Defect Report of the incident flight was as follows:

'Return Back due to High Vibration Engine Number 2. Overweight LDG not applicable. ENG parameter normal.'

During physical inspection on arrival, the blood stains were observed spread on the acoustic panel of Engine # 2 between 7 O'clock till 11 O'clock positions (forward looking aft).



Figure # 3
Blood stains of bird

The aircraft was released for service on 21st June 2017 at 13:10 hrs after following rectification action:

- a) TSM for high engine vibration was followed and observed bird strike on Engine # 2 affecting fan blades # 21 & 22 with distortion and shingling. Rest all blades found normal.
- b) Engine bird strike inspection carried out. No core ingestion observed and no missing fan blade material.
- c) Fan blades # 21 & 22 replaced.
- d) High power run-up for vibration survey carried out, vibrations found within limits without noise or rumble.
- e) All related reports FADEC 1 & 2 test, Last Leg Report, post Engine # 1 & 2 ground run Post Flight Report found satisfactory.
- f) Engine # 1 & 2 MMCD & EMCD pop out checked found satisfactory.
- g) No related fault on Post Flight Report and Engine Warning Display status page normal.
- h) Boroscope Inspection to be carried out within 25 flight hours or 10 flight cycles (whichever comes first).

Boroscope Inspection of Engine # 2 was carried out on 22/06/2017 at 27592:02 hrs A/c TSN & 17565 A/c CSN and found satisfactory

Maintenance Post Flight Report for the incident flight is as follows:

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A/C ID   DATE   GMT   FLTN   CITY PAIR
.VT-GOS  21JUN  0644  GOW338  VIDP VIDP

-----
: MAINTENANCE :           DB/N
: POST FLIGHT REPORT :       A320F1V4
:-----

A/C ID   DATE   GMT   FLTN   CITY PAIR
.VT-GOS  21JUN  0534/0601  GOW338  VIDP VIDP

WARNING/MAINT.STATUS MESSAGES
-----
GMT  PH  ATA
0541 06 21-61 AIR PACK 1+2 FAULT (3)
0541 06 27-00 ENG 1 SHUT DOWN
0541 06 22-00 AUTO FLT AP OFF
0541 06 23-28 COM SATCOM FAULT
0544 06 27-00 ENG 1 START VALVE FAULT (2)
0545 06 22-00 AUTO FLT AP OFF

FAILURE MESSAGES
-----
GMT  PH  ATA                               SOURCE  IDENT.
0535 02 23-13-13 RMP3(1RG3)/RMP2(1RG2)  RMP1,2OR3
0535 02 23-13-13 RMP3(1RG3)/RMP1(1RG1)  RMP1,2OR3
0541 06 27-51-34 SFCC1                    EFCS 1
0542 06 23-28-34 NO SDU DATA (INTM)     CFDS           ECAM 2
                                                ECAM 1
                                                ATSU
0542 06 28-42-34 FWC1 :NO DATA FROM     ECAM 2         ECAM 1
                    FQI1A/1B
0542 06 24-22-55 AFS:28V PWR 11XU1       AFS
0544 06 00-11-00 START AIR, SAV          ENG1A          EIUIFADEC

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Figure # 4 Maintenance Post Flight Report of the incident flight

Maintenance Post Report indicates that the Engine # 1 was shut down at 05:41 hrs and its associated warning/ maintenance status messages and failure messages came on. Engine # 1 Start Valve Fault came at 05:44 hrs.

1.7 Meteorological Information:

Meteorological information is provided by Indian Meteorological Department in every 30 minutes. The weather at Delhi, as per Indian Meteorological Department, was reported as follows:

Time	0500	0530	0600
Wind	110/ 09 Knots	100/ 09 Knots	100/ 07 Knots
Visibility	2500 meter	2500 meter	2500 meter
Clouds	FEW040 SCT100	FEW040 SCT100	FEW040 SCT100

Obscuration	Haze	Haze	Haze
Temperature	31 °C	31 °C	32 °C
Dew Point	24 °C	24 °C	24 °C
QNH	1001 hPa	1001 hPa	1001 hPa
Cloud coverage	Non-significative	Non-significative	Non-significative

During take-off, surface winds reported was 150° and 07 knots. However, as per the occurrence report, after take-off, the weather was very turbulent.

Meteorological report was available with the crew for briefing before flight.

1.8 Aids to Navigation:

Aircraft is equipped with navigation aids such as ADF, ILS, GPS, VOR, DME, ATC Transponder and Weather Radar.

Runway 09 at IGI Airport, Delhi is equipped with Simple Approach Lighting System and runway 10 is equipped with Cat I ILS (DME collocated with glide path). Other navigation aids installed at IGI Airport, Delhi include Cat III B ILS, DVOR, DME and NDB with Precision and Non-Precision approach procedures. It has also a secondary surveillance RADAR for providing route navigation services.

There were no known navigation aid difficulties reported by the crew.

1.9 Communication:

Aircraft is equipped with Very High Frequency sets and a High Frequency set for communication. There was always two-way communication established between the ATC and aircraft.

1.10 Aerodrome Information:

Indira Gandhi International Airport (IATA: DEL, ICAO: VIDP) is the primary international airport of the National Capital Region of Delhi. IGI Airport, Delhi is being operated, managed and developed by Delhi International Airport Limited, a consortium led by the GMR Group. The ATC is controlled by Airports Authority of India.

The elevation of the airport is 777 ft, and it has three runways: runway 11/29, 4,430 m × 60 m (14,534 ft × 197 ft), runway 10/28, 3,810 m × 45 m (12,500 ft × 148 ft), and runway 09/27, 2,813 m × 45 m (9,229 ft × 148 ft).

As per the electronic Aeronautical Information Publication (e-AIP) of IGI Airport, declared distances for runways are as under:

Runway Designation	TORA from Taxi way (m)	TORA (m)	TODA (m)	ASDA (m)	LDA (m)
09	E3: 2673				
	K: 2813	2813	3246	2813	2813
	D: 1833				
10	E4: 3235				
	M: 2760				
	N: 3810	3810	3810	3810	3810
	K: 3810				
	D: 2760				
	M2: 3235				

Aircraft entered runway 09 via E3 for departure which indicates aircraft had 2673 m of take-off run available for take-off.

Aerodrome category for rescue & firefighting is CAT-10 for all the facilities of IGI Airport. Type of operations permitted is IFR/VFR.

Wildlife Hazard Management at IGI Airport, Delhi:

In the Aerodrome Manual of IGI Airport, Delhi, following measures to control wildlife hazard are outlined:

- Regular grass cutting is being carried out in the operational area and in particular in the basic strips of runways to prevent bird attraction. The height of the grass in the operational area is being maintained as recommended by the WHM consultants as per species specific requirement to reduce bird concentration in airfield. Various types of grass cutting machines are used to suit the terrain and vegetation types.

- Biocides/Insecticides/weedicides are applied on vegetation through spraying machines regularly in the operational area, specifically on the runway strips to control breeding of earth rodents, worms, termites and other insects fed on by birds and animals.
- The garbage disposal by the flight kitchens is regularly monitored to ensure that they don't dump the garbage outside the airport in open areas. Regular garbage disposal is carried out from within the operational area in closed polythene bags.
- Bird chasers are deployed between dawn to dusk in two shifts to chase away the birds.
- Entire airport ground is being levelled and graded and low-lying areas within the operational area are being filled to prevent water stagnation and consequent bird attraction/ concentration.
- The drains in the operational area are cleaned and de-silted regularly. However, a special drive is conducted before monsoons to clean the drains.
- For cleaning the runways, taxiways, service roads, Parking bays and entire apron areas, Runway Mechanical Sweepers are deployed. To supplement this, contractual labours are also employed to clean the entire area of all types of debris and FOD.
- Distress-call based bird scaring device are installed in all operational vehicle.
- Periodic inspection of areas in 10 Km radius of Aerodrome Reference Point of IGI Airport is conducted along with the Municipal Corporation of Delhi, Delhi Development Authority and Delhi Police officials. The observations are forwarded to all concerned higher officials for follow up action and review in Airfield Environment Management Subcommittee.
- Strengthening of boundary walls and double grating of drain outlets.
- The unresolved bird hazard/environmental problems are referred to Airfield Environment Management Committee meeting chaired by Secretary, Environment and solutions arrived after robust discussions.
- All the access gates on perimeter wall and fencing are manned by Aviation Security Group officials controlling the entry of animals into operational area through these gates.

Though above-mentioned measures are in place to contain wildlife hazard it is seen that the number of bird strikes was increased substantially during the period from April 2017 – August 2017.

Bird Strike data of IGI Airport, Delhi as per ATC, Delhi is as follows:

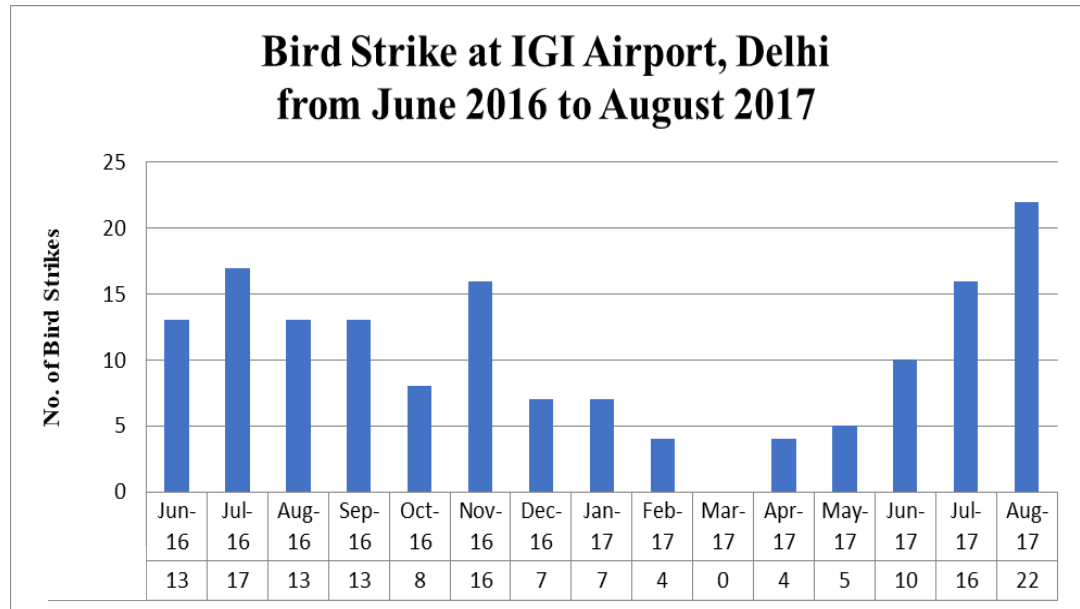


Figure # 5 No. of Bird Strikes reported at IGI Airport, Delhi

As per the details provided by DIAL, it is seen that only two AEMC meetings were held in two years period, i.e. 2016 & 2017. PART 5 ‘Aerodrome Administration and Safety Management System’ Chapter 5.3 ‘Airport Committees’ of Aerodrome Manual of IGI Airport, Delhi stipulates to held AEMC meetings at every six months interval for enhancing the aircraft safety by risk management. However, DIAL has claimed that in order to have proper follow ups on the observations, the AEMC Sub- committee meetings are held in the intervening period.

On 21st June 2017, as per the Apron Log, Runway 09/27 was inspected by Follow Me # 1 along with security staff from 02:32 hrs to 02:36 hrs on 21st June 2017. Bird Scarer # 28 entered Runway 09 via D to E5 to scare birds from 05:07 hrs to 05:10 hrs on 21st June 2017. Bird Scarer # 28 entered Runway 27 via E to E5 from 06:06 hrs to 06:07 hrs on 21st June 2017.

1.11 Flight Recorders:

Relevant portion of CVR tape transcript is reproduced below:

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:37:50	TOWER	GO AIR 338 DELHI TOWER NAMASHKAR. LINE UP RUNWAY 09 VIA ECCO3	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:37:54	FO	LINE UP 09A VIA ECCO3 GO AIR 338.	
05:39:34	FO	BEFORE TAKE-OFF CHECKLIST COMPLETE	Crew completed 'Before Take-off Checks'
05:39:47	FO	WE ARE READY FOR DEPARTURE GO AIR 338	
05:39:49	TOWER	GO AIR 338. RUNWAY 09 CLEAR FOR TAKE-OFF SURFACE WIND 150 DEGREE 07 KNOTS.	
05:39:53	FO	RUNWAY 09 CLEAR FOR TAKE-OFF GO AIR 338.	
05:39:56	PIC	TAKE -OFF	
05:40:26	FO	100 KNOTS	
05:40:29	PIC	HEY WHAT IS THAT?	Probable bird strike
05:40:30	FO	I DON'T KNOW	
05:40:33	FO	DO YOU WANT TO REJECT?	ECAM advisory for high N1 vibration of Engine # 2 came up which was not called out by FO.
05:40:35	PIC	NO. I DON'T WANT TO REJECT	
05:40:36	FO	OK.	
05:40:38	FO	V ₁ ROTATE.	
05:40:42	PIC	GEAR UP	
05:40:44	FO	GEAR UP	
05:41:03	FO	OK. ENGINE VIBRATION NO1 IS OUT OF LIMIT.	Incorrect assessment of situation. First Officer interpreted N1 as Number # 1.
05:41:13	TOWER	GO AIR 338 TOWER	
05:41:14	FO	STAND BY SIR	
05:41:16	PIC	WHICH VIBRATION WAS?	
05:41:17	FO	NO2 NO2...VIBRATIONS	In subsequent conversations, First Officer is confused and still calling out the incorrect information. PIC reduced the throttle on Engine # 1 followed by complete shutdown (Master off)
05:41:19	FO	YA	
05:41:21	FO	VIBRATION OF NO2 ...UHH..NO1 IS QUITE HIGH	
05:41:25	PIC	WHICH HAS A VIBRATION HIGH?	
05:41:26	FO	VIBRATION NO.1 WAS VERY HIGH	
05:41:32	PIC	WHAT IS VIBRATION?	
05:41:33	FO	VIBRATION IS 8.2 ON NO.1	
05:41:35	PIC	I AM BRINGING IT BACK	
05:41:36	FO	YA	
05:41:37	PIC	& NO.2?	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:41:38	FO	UHHH... NO.2 IS WITHIN THE LIMITSwithout referring to QRH.
05:41:40	FO	NO.1 IS GOING TOO HIGH.	
05:41:45	FO	SHALL I TELL HIM THAT WE NEED IMMEDIATE VECTORS FOR LANDING?	
05:41:48	PIC	YA.	
05:41:50	FO	UHHH... DELHI TOWER GO AIR 338, SIR WE ARE DECLARING EMERGENCY. WE HAVE ENGINE NO.1 PROBLEM AND WE HAVE SHUT DOWN ENGINE NO.1. REQUEST VECTORS IMMEDIATELY FOR RUNWAY 09.	Declared emergency
05:42:00	TOWER	ROGER CONTACT RADAR 118.825	
05:42:02	FO	118.825	
05:42:05	PIC	NO.2 IS OK?	
05:42:06	FO	YA NO.2 IS OK	
05:42:07	FO	RADAR GO AIR 338 WE ARE DECLARING EMERGENCY. WE HAVE A PROBLEM WITH ENGINE NO.1 VIBRATION LIMITS. WE ARE ON SINGLE ENGINE PASSING CURRENTLY 2600FT. REQUEST IMMEDIATE VECTORS FOR RUNWAY 09.	
05:42:18	TOWER	GO AIR 338 RADAR	
05:42:19	FO	GO AIR 338. SIR WE ARE DECLARING AN EMERGENCY. WE HAVE A PROBLEM WITH ENGINE NO.1. WE HAVE SHUT DOWN ENGINE 1. WE ARE PASSING CURRENTLY 2700FT. REQUEST IMMEDIATE VECTORS FOR RUNWAY 09.	
05:42:29	TOWER	GO AIR 338 RADAR. ROGER EMERGENCY. UHHH ROGER MAYDAY AND CLIMB. CAN YOU ABLE TO CLIMB SIR?	
05:42:37	PIC	YA	
05:42:38	FO	WE WILL BE ABLE TO CLIMB AT THE MOMENT.	
05:42:39	PIC	WE WANT TO COME BACK.	
05:42:40	FO	WE WANT TO COME DOWN FOR A IMMEDIATE LANDING.	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:42:43	PIC	WHAT IS THE VIBRATION? WHERE IS A VIBRATION?	First Officer repeatedly calling out the incorrect information on engine vibration even after shutdown of Engine # 1. ATC directs to stop climb.
05:42:48	FO	UHHH... NO.1 IS AT 9.9	
05:42:58	TOWER	UHHH.. GO AIR 338. ROGER CLIMB UHHH STOP CLIMB	
05:43:02	FO	STOP CLIMB AT 3000FT AFFIRM?	
05:43:04	TOWER	AFFIRM?	
05:43:05	FO	ALL RIGHT THEN WE ARE STOPPING CLIMB AT 3000FT AND REQUEST RIGHT VECTOR FOR LANDING FOR RUNWAY 09	
05:43:12	PIC	WHERE IS A VIBRATION?	
05:43:14	PIC	WHERE IS A VIBRATION?	
05:43:16	FO	VIBRATION FOR NO.1 IS 9.9. NO.2 IS FINE	
05:43:26	PIC	POINT OUT THE VIBRATION?	
05:43:28	FO	NO.1 9.9 AND 2, 0.2.	
05:43:31	PIC	AND VIBRATION NO.1	
05:43:33	FO	NO.1 IS 0	
05:43:35	PIC	VIBRATION NO.2 IS HIGH NO?	
05:43:42	PIC	I WILL START NO.1 THEN I DON'T KNOW	
05:43:44	FO	OK. WILL START NO.1	
05:43:46	PIC	START ONE	
05:43:48	FO	STARTING NO.1	
05:43:50	TOWER	GO AIR 338 CONFIRM ENGINE NO.1	Engine # 1 is not starting.
05:43:53	PIC/ FO	STEP UP. STEP UP. GO AIR 338.	
05:43:56	TOWER	ENGINE NO.1 NOT....IS SHUT DOWN?	
05:43:58	FO	YES SIR WE HAVE SHUT DOWN ONE ENGINE. WE ARE ON SINGLE ENGINE AT THE MOMENT.	
05:44:02	PIC	START ONE YAAR.	
05:44:03	FO	YA. WILL START. WILL START	
05:44:05	FO	I THINK WE NEED APU BLEED AIR AS WELL, WILL START APU?	
05:44:06	PIC	YA	
05:44:37	PIC	START ENGINE 1 YAAR.	
05:44:38	FO	SIR I HAVE ALREADY....(not clear)..... YA	
05:44:44	FO	CURRENTLY THE BLEED IS NOT AVAILABLE.	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:44:47	PIC	BECAUSE THIS WAY ENGINE WILL CATCH FIRE. TELL HIM IMMEDIATELY WE HAVE TO COME DOWN.	
05:44:51	FO	SIR WE HAVE TO COME DOWN IMMEDIATELY SIR.	
05:44:58	FO	ENGINE 1 START VALVE FAULT. START VALVE FAULT.	While starting Engine # 1, encountered 'start valve fault'. Crew put cross bleed open and started Engine # 1.
05:45:20	PIC	CROSS BLEED OPEN.	
05:45:48	PIC	NO.1 IS NOT STARTING?	
05:45:50	FO	YA.	
05:45:52	PIC	HMMM..?	
05:45:55	FO	ALRIGHT CAPTAIN	
05:45:57	PIC	NO.1 AVAILABLE?	
05:45:58	FO	NO.1 IS AVAILABLE.	
05:46:06	PIC	NO.1 VIBRATION CHECK	ALPHA FLOOR activated for 28 seconds.
05:46:07	FO	YA. ENGINE VIBRATION IS WITHIN LIMITS.	
05:46:09	PIC	HUHH?	
05:46:10	FO	YA. ENGINE VIBRATIONS ARE WITHIN THE LIMITS.	
05:46:21	FO	OK. I WILL GIVE IT FLAP ZERO	
05:46:23	PIC	FLAP ZERO. FLAP ZERO.	
05:46:24	FO	TAKE THE FLAP ZERO.	
05:46:25	FO	OK. WE ARE IN TOGA LOCK AT THE MOMENT.	
05:46:30	PIC	I THINK NO...JUST CHECK NO.1 VIBRATION.	
05:46:33	FO	YA NO.1 VIBRATION WITHIN LIMITS.	
05:46:35	PIC	WITHIN LIMITS?	
05:46:35	FO	YA. WITHIN LIMITS	
05:46:48	FO	SIR NOT GETTING ANY POWER ON ANY ENGINE.	
05:46:51	PIC	WE ARE GETTING	
05:46:52	FO	YA.	
05:46:53	PIC	WE ARE GETTING POWER ON NO.1	Power from Engine # 1 is available.
05:46:59	PIC	NO? NO POWER ON NO.1?	
05:47:00	CABIN CREW	CAPTAIN...UHH...CAPTAIN WANTS TO COME INSIDE THE COCKPIT.	Probably Staff on Duty wants to come inside cockpit
05:47:02	FO	YA	
05:47:05	FO	CAPTAIN WANTS TO COME INSIDE THE COCKPIT. YA COME IN	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:47:10	PIC	WE ARE GETTING POWER ON NO.1	
05:47:12	FO	BUT SIR I CAN'T FEEL ANY THRUST	
05:47:15	PIC	YA.	
05:47:16	PIC	NOW ITS FINE.	
05:48:16	PIC	NO.2 IS THE PROBLEM....(<i>not clear</i>).....	Deliberations with SOD in cockpit
05:48:25	FO(<i>not clear</i>).....BECAUSE OF HIGH VIBRATION	
05:48:28	SOD	IS NO.2 MAKING NOISE?	
05:48:29	FO	YES...NO.2 WAS MAKING NOISE	
05:48:34	PIC	OK ONE MINUTE....(<i>not clear</i>).....	Deliberations with SOD in cockpit
05:48:49	FO	STANDBY....(<i>not clear</i>).....	
05:50:47	FO	WE CONFIRM CLEAR FOR THE APPROACH	
05:50:49	TOWER	GO AIR 338 CLEAR TO LAND RUNWAY 10 WIND 120 DEGREE 08KNOTS. REPORT VISUAL	Landing clearance granted by ATC
05:50:55	PIC	TELL HIM WE WOULD LIKE TO DO ONE CIRCUIT	Crew decided to carry out go around. Requested ATC to do one more circuit which was granted by ATC.
05:50:57	FO	SIR WE WOULD LIKE TO DO ONE MORE CIRCUIT BECAUSE WE ARE TOO HIGH ON THE GLIDE AT A MOMENT	
05:51:01	TOWER	GO AIR 338 LEAVE THE LOCALIZER. TURN RIGHT HEADING 240	
05:51:04	FO	LEAVE THE LOCALIZER. TURN RIGHT HEADING 240	
05:55:19	FO	ESTABLISHED LOCALIZER RUNWAY 10 GO AIR 338	
05:55:22	TOWER	ROGER CLEARED FOR ILS	
05:55:23	FO	CLEARED FOR ILS GO AIR 338	
05:55:25	TOWER	SAY AGAIN ENDURANCE ONLY	
05:55:27	FO	SIR WE ARE ABOUT 8.2 TONNES	
05:55:33	TOWER	GO AIR 338 CLEARED TO ILS 10. SEVEN AND HALF MILES FROM TOUCHDOWN CLEARED TO LAND RUNWAY10 WIND 100.08 KNOTS	Landing clearance granted by ATC
05:55:49	FO	CREW AT STATIONS FOR LANDING. THANK YOU	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
05:56:00	TOWER	GO AIR 338 CLEARED TO LAND RUNWAY 10. SIX MILES FROM TOUCHDOWN. ON GLIDE CONTACT TOWER 118.1	
05:56:06	FO	ON GLIDE CONTACT TOWER 118.1 GO AIR 338	
05:56:10	FO	TOWER GO AIR 338 ILS RUNWAY 10	
05:56:13	TOWER	GO AIR 338 TOWER RUNWAY 10. CLEARED TO LAND. WIND IS 090 DEGREES 05 KNOTS	
05:56:17	FO	090.05 KNOTS GO AIR 338	
05:56:38	SOD	CABIN CREW CLEARED....(<i>not clear</i>).....FOR LANDING PLEASE	Call on PA system made by Staff on Duty
05:58:57	FO	VACATING 'F' GO AIR 338	
05:58:59	TOWER	ROGER APPROVED	
05:59:21	FO	CHANGE OVER TO GROUND GO AIR 338	
05:59:23	TOWER	ROGER 121.75	
05:59:25	FO	121.75	
05:59:26	FO	GROUND GO AIR 338 VACATING VIA 'F'	
05:59:29	TOWER	GO AIR 338 GROUND TAXI VIA 'B3' STAND 121	
05:59:33	FO	'B3' AND STAND 121 GO AIR 338 REGISTRATION VT-GOS	
05:59:40	TOWER	CORRECTION VIA 'E' 121	
05:59:44	FO	VIA 'E' AND STAND 121	
05:59:46	TOWER	CONFIRM VTGOS	
05:59:48	FO	AFFIRM	
05:59:49	TOWER	ROGER	
05:59:57	PIC	UHH....WHAT DID HE SAY?	
05:59:58	FO	'E'. 'E' AND STAND 121	
06:00:02	FO	THIS SIDE IT IS	
06:00:04	PIC	'E' IS THIS ONE	
06:00:06	FO	YOUR LEFT	
06:00:34	FO	I DON'T THINK WE WILL BE ABLE TO TURN	
06:00:39	PIC	WHY IS THE MARSHALLER THERE?	
06:00:43	PIC	HUHH?	
06:00:44	PIC	WHICH IS THE BAY NUMBER THEY HAVE GIVEN TO US?	
06:00:46	PIC	HUHH?	

TIME (Hrs)	FROM	CONVERSATION	REMARKS
06:00:47	FO	121	
06:00:49	FO	THIS IS THE ONE	
06:01:00	FM8	GROUND FOLLOW ME 8	
06:01:01	GROUND	GO AHEAD	
06:01:02	FM8	ASK AIRCRAFT TO HOLD POSITION GO AIR	Follow Me asked Ground to advise aircraft to hold position & switch off engine as the aircraft took a wrong turn for parking
06:01:06	GROUND	GO AIR 338 HOLD POSITION	
06:01:07	FO	HOLDING POSITION GO AIR 338	
06:01:12	FO	SIR WE HAVE TO CONTINUE 'E' AND WE HAVE TO COME LIKE THIS	
06:01:14	FM8	GROUND FOLLOW ME 8. ASK AIRCRAFT TO SWITCH OFF ENGINE. WILL TOW THE AIRCRAFT FROM THEIR POSITION	
06:01:22	PIC	TELL HIM. HE WANT US TO SHUT DOWN	
06:01:25	FO	APPRON YOU WANT US TO SHUT DOWN THE ENGINES FOR GO AIR 338	
06:01:28	GROUND	FURTHER VIA TOW	
06:01:29	FO	YA. ALRIGHT WE ARE SHUTTING DOWN THE ENGINE. FURTHER VIA TOW	
06:01:32	GROUND	ROGER	

Following are the salient observations made from CVR & FDR:

TIME (Hrs)	EVENTS
05:39:34	Crew completed 'Before Take-off Checks'.
05:39:53	Take-off clearance was granted by ATC.
05:40:29	Probably aircraft suffered with bird strike on Engine # 2 while take-off roll at 115 knots IAS/ 112 knots of ground speed. N1 of Engine # 2: 5.2.
05:40:32	ECAM advisory for high N1 vibration of Engine # 2 came up at 129 knots IAS/ 125 knots of ground speed which was not called out by First Officer. N1 of Engine # 1: 0.2 and N1 of Engine # 2: 9.9.

TIME (Hrs)	EVENTS
05:40:33	FO inquired PIC to reject take-off. IAS: 129 knots.
05:40:40	Aircraft lifted off at 155 knots IAS.
05:40:44	Aircraft fully airborne at 163 knots IAS.
05:41:03	Incorrect assessment of the situation by First Officer. First Officer interpreted N1 as Number # 1.
05:41:09	Engine # 1 put on IDLE. Engine # 2 put on CLIMB. Altitude: 2172 ft.
05:41:10	Engine # 2 put on TO/GA. Altitude: 2192 ft.
05:41:21	FO confused about identification of affected engine and communicating incorrect information.
05:41:48	Engine # 1 master off. Engine # 2 on TO/GA. Altitude: 2692 ft.
05:41:50	Crew declared emergency to ATC, Delhi and requested for immediate return back to land back at Delhi. Autopilot disengaged. Altitude: 2704 ft, IAS: 152 knots.
05:42:48	FO repeating the incorrect information even after Engine # 1 shutdown.
05:43:13	Aircraft stopped climbing at 3330 ft altitude on directions of ATC.
05:43:16	FO repeating the incorrect information even after Engine # 1 shutdown.
05:43:42	Crew realized that they had identified issue of vibrations on incorrect engine. Crew initiated starting of Engine # 1. Altitude: 3336 ft.
05:43:49	Engine # 1 master on. Engine # 2 on CLIMB. Cross Bleed Valve position: Fully Close. Altitude 3336 ft.
05:44:15	Engine # 2 put on IDLE. Altitude: 3332 ft.
05:44:57	Engine # 1 'Start Valve Fault' triggered. Cross Bleed Valve position: Fully Close. Altitude: 3332 ft.
05:45:26	Cross Bleed Valve opened.
05:45:42	Engine # 2 put on CLIMB. Altitude: 3332 ft.
05:45:43	Autopilot disengaged. Altitude: 3332 ft, IAS: 127 knots.
05:45:58	First Officer confirmed Engine # 1 is available. N2 of Engine # 1: 60%, Altitude: 3108 ft, IAS: 134 knots.

TIME (Hrs)	EVENTS
05:46:00	Engine # 2 put on IDLE. Altitude: 3056 ft.
05:46:01	Engine # 1 put on CLIMB. ALPHA FLOOR activated. Altitude: 3024 ft, RA: 1986 ft, IAS:139 knots, Flaps: 10 ⁰ , Slats: 18 ⁰ , Pitch: 3.5 ⁰
05:46:25	Aircraft in 'TO/GA Lock'.
05:46:26	Autopilot disengaged. Altitude: 2616 ft, IAS: 212 knots.
05:46:28	Autothrust disengaged. Altitude: 2608 ft, IAS: 221 knots.
05:46:29	ALPHA FLOOR de-activated. Altitude: 2600 ft, RA: 1563 ft, IAS:223 knots, Flaps: 0 ⁰ , Slats: 18 ⁰ , Pitch: -1.5 ⁰
05:46:37	ECAM advisory for high N1 vibration of Engine # 2 went off. N1 of Engine # 1: 0.2 and N1 of Engine # 2: 5.3.
05:46:56	Engine # 1 put on CLIMB. Altitude: 2848 ft N1 of Engine # 1: 1.1 and N1 of Engine # 2: 1.2.
05:47:05	SOD, company FATA pilot as per PIC & FO, enters in cockpit on getting permission from PIC.
05:50:49	Landing clearance granted by ATC.
05:50:57	Crew requested Go around to ATC.
05:51:07	Crew initiated Go around.
05:55:33	Landing clearance granted by ATC.
05:56:38	SOD made a call on PA system.
05:58:32	Aircraft touched down.
05:58:36	Aircraft landed.
06:01:28	Ground advised crew to shutdown the engines.
06:01:40	Engine # 2 master off.
06:01:41	Engine # 1 master off.
----	Crew did not complete the 'Take-off Checks' & 'After Take-off Checks'.

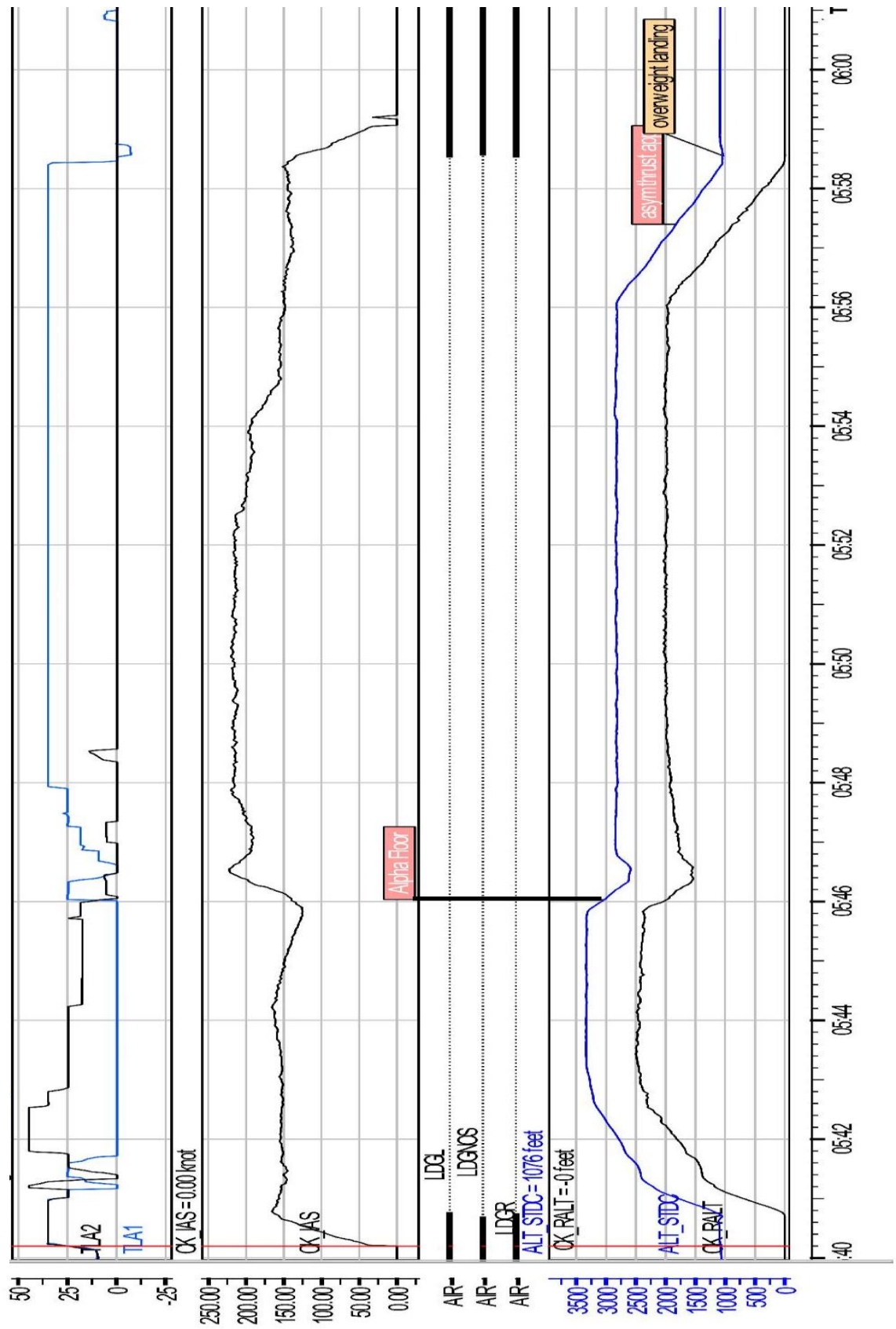


Figure # 6 Graphical representation of FDR data

1.12 Wreckage and impact information: Nil.

1.13 Medical and pathological information: Both the crew had undergone Pre-flight medical examination before operating their first flight of the day at Bangalore and tested negative for consumption of alcohol.

1.14 Fire: There was no fire before or after the incident.

1.15 Survival Aspects: No human injuries were reported in the incident.

1.16 Tests and research: Nil.

1.17 Organizational and Management Information:

M/s Go Airlines (India) Ltd. is a scheduled airline with a fleet of Airbus A-320 aircraft operating its flights on domestic and international sectors. M/s Go Airlines (India) Ltd. is a low-cost carrier based in Mumbai, India. It operates under the brand Go Air. M/s Go Airlines (India) Ltd. launched its operations in November 2005 and currently has 32 aircraft as part of its fleet.

1.18 Additional Information:

- After deactivation of ALPHA FLOOR, SOD entered in the cockpit after pressing cockpit buzzer several times. PIC submitted that he allowed SOD inside cockpit because the buzzer was distracting.
- SOD is asking information of the problem to cockpit crew while they were performing their duties while in flight and after landing as well. SOD was inside the cockpit till the aircraft was parked and had made one call on PA system also.
- As per PIC, there was no information by ATC about bird activity but Air Traffic Information Services reported bird activity in its broadcast.

1.19 Useful or Effective Investigation Techniques: None.

2. ANALYSIS:

2.1 Engineering aspects:

Airworthiness Review Certificate of the aircraft was valid up to 10/03/2018. Aircraft TSN was 27589: 56 hrs and CSN was 17563. Last major maintenance, i.e. 1A check, was accomplished on 06/05/2017 at 27061:01 hrs A/c TSN/ 17204 A/c CSN and next due at 06/09/2017 or 27811:01 hrs A/c TSN or 17954 A/c CSN whichever earlier. Aircraft was flying with valid Certificate of Release to Service on 21/06/2017. Aircraft was subjected to Daily Inspection schedule and Pre-departure schedule before release to service and had flown for two sectors uneventfully before the incident flight. Scrutiny of the maintenance records reveals that there was no relevant snag open for rectification and there was no active MEL invoked with regard to relevant aircraft systems. No other abnormality in the operation of aircraft was reported by the crew except high vibration on Engine # 2 on 21/06/2017. Aircraft Load & Trim sheet was prepared and Centre of Gravity was found within limits. Boroscope Inspection of Engine # 2 was carried out on 22/06/2017 at 27592:02 hrs A/c TSN/ 17565 A/c CSN and it did not reveal any abnormality. Thus, the aircraft was considered airworthy and serviceable before the incident flight. Hence, airworthiness and serviceability of the aircraft is not a factor to this incident.

2.2 Operational aspects:

- Both the crew members were medically fit, had adequate rest and found to be within FDTL limits before they operated flight on June 21st 2017. Medical fitness & FDTL is not considered as a factor to this incident.
- Crew had completed 'Before Take-off checks'.
- Aircraft suffered with bird strike on engine # 2 while take-off roll at 5:40:29 hrs at around 115 knots IAS. V_1 , V_R & V_2 were calculated to be 146 knots, 146 knots & 147 knots respectively. Both crew observed abnormal sound & vibrations in cockpit. At 5:40:32 hrs at 129 knots IAS, ECAM Advisory with regard to N1 vibrations of Engine # 2 was displayed, which was not called out by First Officer. However, First Officer enquired PIC for rejecting take off.
- PIC could have rejected take-off as speed was well below V_1 , but as the aircraft was in high speed range he was not sure that the aircraft would stop within the available runway, if executed rejected take-off. Having no input with regard to engine # 2 vibrations, and probable intention to investigate the problem after getting airborne, PIC continued for take-off.

- As per FCTM Abnormal and Emergency Procedures:

- **Below 100 kt:**

The decision to reject the takeoff may be taken at the Captain's discretion, depending on the circumstances.

The Captain should seriously consider discontinuing the takeoff, if any ECAM warning/caution is activated.

- **Above 100 kt, and below V1:**

Rejecting the takeoff at these speeds is a more serious matter, particularly on slippery runways. It could lead to a hazardous situation, if the speed is approaching V1. At these speeds, the Captain should be "go-minded" and very few situations should lead to the decision to reject the takeoff:

1. Fire warning, or severe damage
2. Sudden loss of engine thrust
3. Malfunctions or conditions that give unambiguous indications that the aircraft will not fly safely
4. Any red ECAM warning
5. Any amber ECAM caution listed below:
 - F/CTL SIDESTICK FAULT
 - ENG FAIL
 - ENG REVERSER FAULT
 - ENG REVERSE UNLOCKED
 - ENG 1(2) THR LEVER FAULT

During take-off roll, there was no input from First Officer regarding high engine vibrations and further there was no red ECAM warning and amber ECAM caution. PIC's decision to continue for take-off, in absence of any abnormal input from First Officer, was in line with FCTM guidelines.

- Crew did not complete 'Take-off checks' & 'After Take-off checks'.

- The Engine vibration advisory and the vibration values are shown on Lower ECAM as follows:



Figure # 7 ECAM display- For illustration purpose only

- On getting airborne, First Officer observed the Lower ECAM Advisory and N1 was incorrectly identified as Number # 1. However, vibration N1 in the Lower ECAM corresponds to fan vibration; and Left & Right positions of the readings corresponds to Number # 1 & Number # 2 engines respectively. The readings on left side of the vibration N1 were not catered for by the First Officer at this stage.

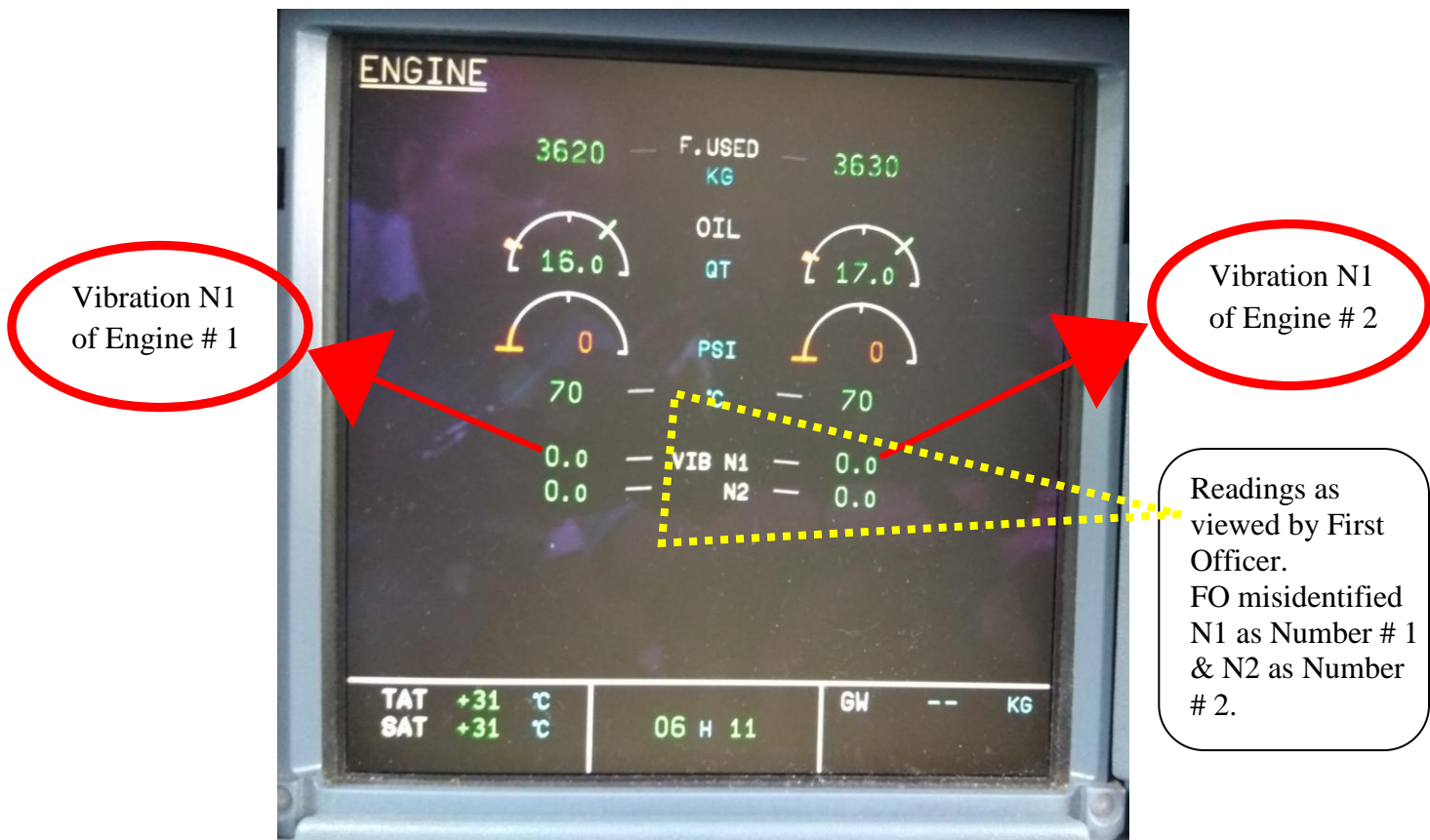


Figure # 8 Lower ECAM display- For illustration purpose only

First Officer misinterpreted the reading vibration N1 of Engine # 2 as vibration of Engine # 1 and called out Number # 1 vibration out of limit. The situation was wrongly assessed by First Officer.

Subsequently on being inquired by the PIC, First Officer seemed confused and communicated to PIC that the high vibration problem is with Engine # 1.

- QRH action for the high engine vibration is as follows:

HIGH ENGINE VIBRATION	
ENG PARAMETERS.....	CHECK
■ If icing suspected: 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.</i>	
■ If icing not suspected:	
<ul style="list-style-type: none"> ● If above vibration advisory and flight conditions permit: THRUST (affected engine)..... REDUCE BELOW ADVISORY THRESHOLD ● After landing : SHUT DOWN ENGINE WHEN POSSIBLE 	

As per QRH:

Crew is supposed to do		Crew has done
1.	Check engine parameters	Crew checked parameters but identification of engine suffering from high vibrations was incorrect. Crew identified Engine # 1 instead of Engine # 2.
2.	If above vibration advisory and flight conditions permit, reduce thrust of the affected engine below advisory threshold	Crew shutdown the Engine # 1, which was not suffering from high vibrations.
3.	After landing, shut down engine when possible	-----

Crew actions for high engine vibrations were not in accordance with QRH procedure.

- Crew were prompt in declaring emergency to ATC.
- Even after shutting down Engine # 1, First Officer was repeatedly prompting PIC and communicating to ATC that high vibration is on Engine # 1. However, readings observed by First Officer were observed to be correct in terms of its value all the times. PIC never checked and confirmed the observations of the First Officer, even though the vibrations did not subside on shutdown of Engine # 1. First Officer submitted that the confusion and misinterpretation in identifying the vibration values between engines was caused due to high work load.

- PIC & First Officer both submitted that they experienced airframe and engine vibrations during and after take-off. Both crew could not realize the actual problem immediately, even after the vibrations did not subside, consequent to shutdown of Engine # 1. After nearly two minutes of shutting down Engine # 1, they could identify actual problem, i.e. high N1 vibrations on Engine # 2.
 - 5:40:44 hrs – Aircraft got airborne
 - 5:41:03 hrs - Detected high vibrations but identified incorrect engine
 - 5:41:48 hrs - Shutdown Engine # 1
 - 5:43:42 hrs - Realized mistake and initiated starting of Engine # 1
- While starting Engine # 1, ‘Engine # 1 Start Valve Fault’ triggered.

As per QRH, Engine Relight Envelope for relighting the engine in flight is depicted below:

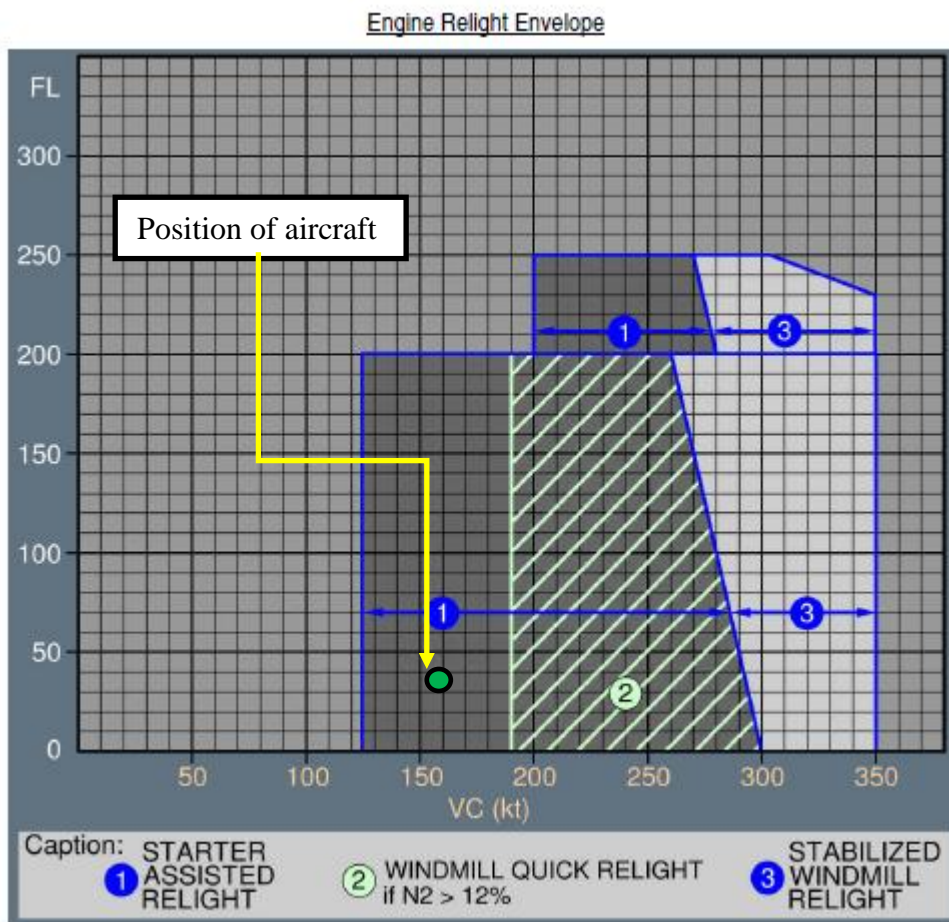


Figure # 9 Engine Relight Envelope

Crew realized the mistake of shutting down the wrong engine at 05:43:42 hrs and initiated starting of Engine # 1 at 05:43:46 hrs. The values pertaining to altitude, IAS and N2 of Engine # 1 at this stage are as follows:

- Altitude: 3336 ft
- IAS: 159 knots
- N2 of Eng # 1: 1%

In view of above, it is derived that the aircraft was flying in envelope # 1 - 'Starter Assisted Relight' envelope. In this envelope, assistance of starter is required for the relighting of engine in flight.

- QRH procedure for relighting the engine in flight is as follows:

[QRH] ENG RELIGHT IN FLIGHT	
ENG MASTER (affected engine).....	OFF
THR LEVER (affected engine).....	Check IDLE
ENG MODE sel.....	IGN
X BLEED.....	OPEN
<i>If outside the windmilling start envelope, the FADEC will open the starter valve.</i>	
WING ANTI ICE (for starter assist).....	OFF
ENG MASTER (affected engine).....	ON
ENG PARAMETERS (N2, EGT).....	MONITOR
<i>Engine light up should be achieved within 30 s after fuel flow increases.</i>	

QRH procedure outlines to put the cross bleed 'open' before putting the master of the engine to 'on'. However, from the FDR data it is observed that the master of the Engine # 1 was put 'on' at 05:43:49 hrs without putting the cross bleed to 'open'.

Non - adherence to the engine relight procedure in flight led to triggering of 'Engine # 1 Start Valve Fault'. Subsequently, crew put the cross bleed valve open at 05:45:26 hrs.

- Power from Engine # 1 was found to be available at 05:45:58 hrs at an altitude of 3108 ft. The throttle of the affected Engine # 2 was later reduced as per QRH procedure and put on to IDLE at 05:46:00 hrs.
- The power only from the affected engine was utilized for over three minutes while the healthy engine was shutdown.

- Autopilot was disengaged at 05:41:50 hrs and several times from 05:45:43 hrs to 05:46:44 hrs, which is corroborated with occurrence report indicating turbulent weather after take-off.
- In the process of starting of Engine # 1, crew did not monitor the decreasing speed of the aircraft; resulting into considerable loss of energy under the deficiency of the power for a brief period combined with the handling the aircraft without autopilot, probably lead to activation of ALPHA FLOOR at 3024 ft and 139 knots IAS. Due to activation of ALPHA FLOOR aircraft got TO/GA thrust from both the engines as the autothrust was already engaged. 'TO/GA LOCK' appeared after 24 seconds of activation of ALPHA FLOOR.
- As per the FCOM:

ALPHA FLOOR calls up the following indications:

- "A FLOOR" in green, surrounded by a flashing amber box on the FMA, and in amber on the engine warning display, (as long as α -floor conditions are met)
- "TOGA LK" in green, surrounded by a flashing amber box on the FMA, when the aircraft leaves the α -floor conditions. TOGA thrust is frozen.

To cancel ALPHA FLOOR or TOGA LK thrust, the flight crew must disconnect the autothrust.

Accordingly, crew disengaged autothrust after three seconds of getting TO/GA LOCK at 221 knots IAS and immediately ALPHA FLOOR was deactivated. Crew actions were appropriate and as per FCOM for deactivation of ALPHA FLOOR.

- After deactivation of ALPHA FLOOR, the ECAM advisory for high N1 vibration of Engine # 2 went off as the throttle of Engine # 2 was already at IDLE. Value of N1 vibration of Engine # 2 was above the specified limits (≥ 6) for approximately six minutes with maximum value recorded to be 9.9.
- Crew made go around in first approach as they were high on a glide. Aircraft landed uneventfully in second approach on Runway 10 at Delhi.
- While taxiing to the allocated stand for parking, not realizing their position with respect to parking stand, crew took wrong turn and parked the aircraft in wrong orientation with parking stand. Subsequently, aircraft was towed to reposition it correctly on the allotted parking stand.
- PDR entry in the Tech Log was not appropriately filled up by PIC as significant information like vibration values & shutdown of Engine # 1 were not entered in PDR of Tech Log. Further, it was mentioned in the PDR that overweight landing is not applicable. However, aircraft landing weight was 64770 kg against Maximum Landing Weight 64500 kg.

2.3 Wildlife Hazard Management:

- Aircraft was scheduled to depart from Delhi at 05:15 hrs on 21/06/2017. Aircraft taxied out at 05:33:20 hrs and got airborne at 05:40:44 hrs from Runway 09. Prior to the scheduled departure of G8 – 338, bird scaring activity was undertaken from 05:07 hrs to 05:10 hrs on Runway 09 between D to E5 to scare birds. This indicates that the preventive measure was followed to prevent bird strike before the incident flight.
- However, though the WHM plan is in place and considering that it is being followed, the bird strike data provided by ATC, Delhi is conclusive enough to determine the effectivity of the WHM plan. It is clearly seen from the data that the number of bird strikes are significantly increased during the period from April 2017 to August 2017.
- The frequency of the AEMC meetings are not in compliance of the PART 5 ‘Aerodrome Administration and Safety Management System’ Chapter 5.3 ‘Airport Committees’ of Aerodrome Manual of IGI Airport, Delhi as only two AEMC meetings were conducted in two years period, i.e. 2016 & 2017, instead of one meeting in every six months.
- Identification of species of struck bird could not be carried out as only blood stains were observed on acoustic panel of Engine # 2.

2.4 Circumstances Leading to the Incident:

PIC was the pilot flying and First Officer was the pilot monitoring in the incident flight. After encountering bird strike on Engine # 2 during take-off roll on Runway 09, crew observed abnormal sound and vibrations in the cockpit. First Officer enquired PIC for rejecting take off. Being unsure of the reason, PIC decided to continue for flight probably wanting to investigate the problem after take-off. As the aircraft was in high speed range, though below V_1 , PIC was not sure that the aircraft would stop within the available runway, if executed reject take-off. During take-off roll, First Officer did not call out high N1 vibrations of Engine # 2 as he probably had not noticed ECAM advisory for high N1 vibrations of Engine # 2. After getting airborne First Officer assessed the situation but erroneously identified problem on incorrect engine, i.e. Engine #1. Incorrect inputs were given to PIC with respect to engine suffering from high vibrations. PIC did not refer the QRH for the abnormal situation and instead shutdown the engine which was wrongly identified by the First Officer to be suffering from high vibrations rather than reducing the thrust of the affected engine below advisory threshold. Throttle of the affected engine was increased to TO/GA. During further conversations with PIC and ATC, First Officer repeatedly communicated that

Engine # 1 is affected with high vibrations. PIC never checked and confirmed the observations of the First Officer, even though the vibrations did not subside on shutdown of Engine # 1, till the time he noticed that the high vibration problem is with Engine # 2 but not with Engine # 1. After about two minutes of Engine # 1 shutdown both crew realized that they had assessed the situation incorrectly. They initiated the procedure to relight the Engine # 1 but failed to do so as they did not follow the engine relight procedure in flight. Crew attempted to relight the engine without opening the cross feed valve which resulted in 'Start Valve Fault' as the aircraft was flying in 'Starter Assisted Relight' envelope. The fault was rectified by opening the cross feed valve and power from the Engine # 1 was available. Throttle of Engine # 2 was moved to IDLE as required by QRH procedure. While during the process of starting engine # 1 and rectifying the associated fault, crew did not notice that the speed of the aircraft has decreased considerably, which resulted into considerable loss of energy of the aircraft. Further to this, manual handling of aircraft because of non-availability of autopilot due to turbulent weather probably lead to activation of protective ALPHA FLOOR for 28 seconds. On getting TO/GA LOCK the autothrust was disconnected as per FCOM procedure to deactivate ALPHA FLOOR. ECAM advisory for high N1 vibrations of Engine # 2 went off. Vibration value for N1 of Engine # 2 was above the specified limits (≥ 6) for approximately six minutes with maximum value recorded to be 9.9.

3. CONCLUSION:

3.1 Findings:

- Airworthiness Review Certificate of the aircraft was valid up to 10/03/2018.
- Airworthiness and serviceability of the aircraft is not a factor to this incident.
- Both crew members were having valid licenses while operating incident flight.
- Medical fitness & FDTL is not a factor to this incident.
- Crew had completed 'Before Take-off checks'.
- Aircraft suffered with bird strike on engine # 2 while take-off roll at around 115 knots of the IAS. Both crew observed abnormal sound & vibrations.
- ECAM advisory for high N1 vibrations of Engine # 2 came at 129 knots IAS, which was not called out First Officer as he probably had not noticed it.
- First Officer enquired PIC for rejecting take off. Being unsure of the reason for vibration, PIC decided to continue for flight probably wanting to investigate the problem after take-off. As the aircraft was in high speed range, though below V_1 , PIC was not sure that the aircraft would stop within the available runway, if executed reject take-off.
- PIC's decision to continue for take-off, in absence of any abnormal input from First Officer, was in line with FCTM guidelines.
- Crew did not complete 'Take-off checks' & 'After Take-off checks'.
- After getting airborne, First Officer misinterpreted the reading N1 of Engine # 2 as vibration of Engine # 1 and called out Number # 1 vibration out of limit. The situation was wrongly assessed by First Officer.

- Crew actions were not in accordance with QRH procedure for high engine vibrations. PIC cut the power on Engine # 1 without referring to QRH.
- Crew were prompt in declaring emergency to ATC.
- During further conversations with PIC and ATC after Engine # 1 shut down, First Officer repeatedly communicated that Engine # 1 is affected with high vibrations. PIC never checked and confirmed the observations of the First Officer, even though the vibrations did not subside on shutdown of Engine # 1. Thereafter, PIC noticed that the high vibration problem is with Engine # 2 but not with Engine # 1. After about two minutes of Engine # 1 shutdown both crew realized that they had assessed the situation incorrectly. Both the crew were lacking situational awareness and shown poor Cockpit Resource Management while handling emergency condition.
- Crew did not adhere to the engine relight procedure in flight.
- The power only from the affected engine was utilized for over three minutes while the healthy engine was shutdown.
- While starting of Engine # 1, crew were unaware about the decreasing speed of the aircraft; which resulted into considerable loss of energy under the deficiency of the power for a brief period. This condition, combined with the handling the aircraft without autopilot, probably led to activation of protective ALPHA FLOOR for 28 seconds. Crew actions were appropriate and as per FCOM for deactivation of ALPHA FLOOR.
- Value of N1 vibration of Engine # 2 was above the specified limits (≥ 6) for approximately six minutes with maximum value recorded to be 9.9.
- Aircraft handling in the emergency condition was not effective & appropriate.
- Crew made go around in first approach as they were high on a glide. Aircraft landed uneventfully in second approach on Runway 10 at Delhi.
- While taxiing to the allocated stand for parking, crew took wrong turn and parked the aircraft in wrong orientation with parking stand.
- PIC entered incorrect information about overweight landing applicability and missed to enter significant information like engine vibration values & shutdown of Engine No 1 in PDR of Tech Log.
- Prior to the scheduled departure of incident flight, bird scaring activity was undertaken.
- Though WHM plan is in place, number of bird strikes is seen to be significantly increased during the period from April 2017 to August 2017.
- The frequency of the AEMC meetings are not in compliance of Aerodrome Manual of IGI Airport, Delhi as only two AEMC meetings were conducted in two years period, i.e. 2016 & 2017, instead of one meeting in every six months.
- Identification of species of struck bird could not be carried out as only blood stains were observed on acoustic panel of Engine # 2.

3.2 Causes:

Incident was caused by incorrect identification of engine affected with high vibration followed by non-adherence to recommended procedures, lack of situational awareness, poor Cockpit Resource Management and poor handling of aircraft during emergency subsequent to bird strike.

4. SAFETY RECOMMENDATIONS:

- Suitable corrective action to both crew members as deemed necessary by DGCA Hqrs in view of the above findings.
- DIAL may be advised to adhere to the programmes & procedures outlined in Aerodrome Manual of IGI Airport, Delhi considering the above findings.
- Effectiveness of the existing Wildlife Hazard Management plan may be ascertained and the Wildlife Hazard Management plan may be reviewed, if deemed necessary.



(Pathik Vaghela)
Inquiry Officer, VT- GOS

Date: 05/11/2018

Place: Mumbai

-----END OF REPORT-----

APPENDIX- 1: ALPHA FLOOR (α -floor) PROTECTION

- The aircraft is equipped with the autothrust system. Autothrust is active when it controls thrust or speed. The position of the thrust lever determines the maximum thrust that the autothrust system can command (except in α -floor condition).

The autothrust system, when active:

- Maintains a specific thrust in THRUST mode
- Controls the aircraft speed or Mach in SPEED/MACH mode
- Uses α -floor mode to set maximum thrust when the aircraft angle of attack exceeds a specific threshold

When α -floor is activated, regardless of the initial status of autothrust and the position of the thrust levers, the autothrust activates.

- ALPHA FLOOR is a protection that commands TO/GA thrust, regardless of the thrust levers' positions. This protection is available from lift-off to 100 ft RA on approach.

ALPHA FLOOR calls up the following indications:

- “A FLOOR” in green, surrounded by a flashing amber box on the Flight Mode Annunciator, and in amber on the engine warning display, as long as α -floor conditions are met.
- “TOGA LK” (TO/GA LOCK) in green, surrounded by a flashing amber box on the Flight Mode Annunciator, when the aircraft leaves the α -floor conditions. TO/GA thrust is frozen.

To cancel ALPHA FLOOR or TOGA LK thrust, the flight crew must disconnect the autothrust. ALPHA FLOOR should be cancelled by using the disconnect pushbutton on either thrust lever as soon as a safe speed is regained.

- ALPHA FLOOR protection automatically sets the thrust at TO/GA thrust, when the aircraft reaches a very high angle of attack. The Flight Augmentation Computer generates the signal that triggers the alpha-floor mode. This, in turn, sets TO/GA thrust on the engines, regardless of the thrust lever positions.

APPENDIX- 2: IGI AIRPORT, DELHI RUNWAY 09 CHART

