

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

## **FOREWORD**

*This document has been prepared based upon the evidences collected during the investigation and opinions obtained from the experts. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 11 of Aircraft (Investigation of Accidents and Incidents), Rules 2017 of India.*

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

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## **GLOSSARY**

AAIB	Aircraft Accident Investigation Bureau, India
AGB	Angle Gear Box
AMSL	Above Mean Sea Level
ARC	Airworthiness Review Certificate
ATB	Air Turn Back
ATC	Air Traffic Control
ATPL	Aero
AUW	All Up Weight
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CAR	Civil Aviation Requirements
CEO	Current Engine Option
CPL	Commercial Pilot License
DGCA	Directorate General of Civil Aviation
ECAM	Electronic Centralized Aircraft Monitor
EEC	Electronic Engine Controller
FADEC	Full Authority Digital Engine Control
FRTOL	Flight Radio Telephone Operators License
IATA	International Air Transport Association
GTB	Ground Turn Back
ICAO	International Civil Aviation Organization
IDG	Integrated Drive Generator
IFSD	In-Flight Shut Down
LPT	Low Pressure Turbine
LSOP	Lube and Scavenge Oil Pump
MGB	Main Gear Box

NEO	New Engine Option
OEM	Original Equipment Manufacturer
PHMU	Prognostics And Health Management Unit
PIC	Pilot in Command
PMA	Permanent Magnet Alternator
P&W	Pratt and Whitney
QRH	Quick Reference Handbook
RTO	Reject Take-off
SB	Service Bulletin
SSCVR	Cockpit Voice Recorder
SSDFDR	Digital Flight Data Recorder

**FINAL INVESTIGATION REPORT ON SERIOUS INCIDENT INVOLVING M/S GO AIR**  
**AIRBUS A320 (NEO) AIRCRAFT VT-WGT ON 07/03/2019**

- |     |                                    |   |  |
|-----|------------------------------------|---|--|
| 1.  | <b>Aircraft Type</b>               | : | Airbus A320-271 NEO  |
|     | <b>Nationality</b>                 | : | Indian   |
|     | <b>Registration</b>                | : | VT – WGT   |
| 2.  | <b>Owner</b>                       | : | M/s GY Aviation Lease 1730 Co. Limited                           |
| 3.  | <b>Operator</b>                    | : | Go Airlines (India) Limited                                      |
| 3.  | <b>Pilot – in –Command</b>         | : | ATPL holder  |
|     | <b>Extent of Injuries</b>          | : | Nil  |
| 4.  | <b>First Officer</b>               | : | ATPL Holder  |
|     | <b>Extent of injuries</b>          | : | Nil  |
| 5.  | <b>Place of Serious Incident</b>   | : | Enroute (Near Lucknow)   |
| 6.  | <b>Date &amp; Time of Incident</b> | : | 07 <sup>th</sup> March 2019 & 1219 UTC                           |
| 7.  | <b>Last Point of Departure</b>     | : | Patna Airport  |
| 8.  | <b>Point of Intended Landing</b>   | : | Delhi Airport  |
| 10. | <b>Type of Operation</b>           | : | Scheduled Operation  |
| 11. | <b>Passengers on Board</b>         | : | 134 (Including 04 Cabin Crew Members)                            |
|     | <b>Extent of Injuries</b>          | : | Nil  |
| 12. | <b>Phase of Operation</b>          | : | Cruise   |
| 13. | <b>Type of Occurrence</b>          | : | Diversion due to Engine Failure (Commanded In-Flight Shut Down). |

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

## **SYNOPSIS**

On 07<sup>th</sup> March 2019, M/s Go Air Airbus A320-271 (NEO) aircraft VT-WGT, while operating a scheduled flight from Patna to Delhi was involved in a Serious Incident due to Engine failure (Commanded IFSD of Engine) and had to divert to Lucknow. The aircraft was under the command of an ATPL holder with a co-pilot also an ATPL holder. There were 134 passengers on board the aircraft including 04 cabin crew members.

The aircraft took –off from Patna. While cruising at an altitude of 38,000 feet, ‘ENG 1 Oil CHIP DETECTED’ was triggered on ECAM which was followed by ‘ENG 1 FADEC SYS FAULT’, ‘ENG1 FADEC ALTERNATOR’, ‘ENG1 FADEC’ and ‘ENG1 HEAT SYS FAULT’ on ECAM. Subsequently ‘ENG1 LO PR’ also triggered on ECAM. The engine oil pressure was found reducing below 100 and was reduced to 2 within 05 seconds. The Engine # 1 power was brought back to idle by crew. Thereafter, ‘ENG1 FAIL’ triggered on ECAM. The crew carried out ECAM actions and subsequently commanded IFSD of Engine # 1 was carried out. The aircraft was then diverted to Lucknow. ‘PAN PAN’ was declared by the crew and the aircraft landed safely at Lucknow.

The occurrence was classified as Serious Incident and an investigation to investigate into the probable cause(s) of the serious incident, was instituted under Rule 11 (1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017.



## **1 FACTUAL INFORMATION**

### **1.1 History of the Flight**

On 07<sup>th</sup> March 2019, M/s Go Air Airbus A320-271 (NEO) aircraft VT-WGT, was scheduled to operate flight G8-150 from Patna to Delhi. There was no abnormality reported on the aircraft during any of the previous flights in the day. The aircraft took-off from Patna at around 1138 UTC.

At 1217 UTC, while cruising at an altitude of 38,000 feet 'ENG 1 Oil CHIP DETECTED' was triggered on ECAM which was followed by 'ENG 1 FADEC SYS FAULT, ENG1 FADEC ALTERNATOR', 'ENG1 FADEC and ENG1 HEAT SYS FAULT' on ECAM. Subsequently at 1218 UTC, 'ENG1 LO PR' also triggered on ECAM. The engine oil pressure was found reducing below 100 and was reduced to 2 within 05 seconds. The Engine # 1 power was immediately brought back to idle by crew. Thereafter, at 1219 UTC, 'ENG1 FAIL' triggered on ECAM. The crew carried out ECAM actions and subsequently at 1219 UTC carried out commanded IFSD of Engine # 1.

As the engine parameters were abnormal and the Engine # 1 was Shut Down, the crew decided to divert to Lucknow. 'Land ASAP' amber also came ON. The aircraft at that time was in Varanasi, FIR. The crew declared 'PAN PAN' due one engine failure to ATC. After clearance from Varanasi ATC, aircraft descended to lower level (FL240). The aircraft was then changed over to ATC, Lucknow at 1228 UTC. After obtaining necessary clearances from ATC, Lucknow the aircraft landed uneventfully with single engine at Lucknow at 1247 UTC. Upon landing, the aircraft was taxied to bay. The passengers were disembarked normally. There was no fire and no injury to any occupant on board the aircraft.

During post flight inspection of the engine inlet area and exhaust area, oil traces were found on exhaust area nozzle, tail cone, drain mast & Thrust Reverser (TR) cowl area underneath drain mast. Oil quantity of Engine # 1 was found to be 2 quarts which was 20 quarts at the beginning of flight. The consumption during the sector was abnormal.

Metal particles were observed on ENG # 1 MGB chip collector. The involved engine (Engine # 1) was removed from the aircraft for further detailed examination and aircraft was released for operations. During detailed inspection of AGB/MGB, Main Oil Pump (MOP)/ Integrated Drive Generator (IDG) Gear was found damaged.

### **1.2 Injuries to Persons**

There was no injury to any of the occupant on board the aircraft.

### 1.3 Damage to Aircraft

The damages were confined to Main Gear Box assembly of Engine # 1 and during tear down examination at OEM's facility following salient damages were observed: -

1. The MOP/IDG gear was found fractured.
2. The Gearbox Drive shaft cover was found with wear beyond limits.
3. The Main Gearbox housing was found fractured and holed with deep scoring.
4. Oil passage and jet of Starter Drive Oil Nozzle were found distorted and nicks beyond limit.
5. MGB IDG Deoiler cover was found dented and scored.
6. PMA Gear shaft was found scored with gear teeth found broken.
7. Oil transfer tube was found gouged/nicked.
8. Rollers of Gearbox Gear shaft bearing were found dented.
9. Gear teeth of Deoiler Gear shaft was found broken.
10. Metal debris was found in the Angle Gearbox during disassembly.

### 1.4 Other Damages

Nil

### 1.5 Personnel Information

#### 1.5.1 Pilot – In – Command

Age	50 Years
License	ATPL
Date of Issue	20 <sup>th</sup> March 2009
Valid up to	29 <sup>th</sup> Apr 2022
Endorsements as PIC	A320
Date of last Med. Exam	09 <sup>th</sup> Nov 2018
Med. Exam valid up to	08 <sup>th</sup> Nov 2019
FRT0 License	Valid
Date of issue	05 <sup>th</sup> Jul 2011

Valid up to	04 <sup>th</sup> Jul 2020
IR test done	10 <sup>th</sup> Dec 2018
IR test due	09 <sup>th</sup> Dec 2019
Total flying experience	9037:32 Hrs
Experience on type	2585:37 Hrs
Experience as PIC on type	2382:10 Hrs
Last flown on type	A320
Total flying experience during last 180 days	474:35 Hrs
Total flying experience during last 90 days	197:09 Hrs
Total flying experience during last 30 days	56:42 Hrs
Total flying experience during last 07 Days	24:41 Hrs
Total flying experience during last 24 Hours	07:44 Hrs

#### 1.15.2 Co-Pilot

Age	32 Years
License	ATPL
Date of Issue	13th April 2018
Valid up to	12th April 2023
Date of last Med. Exam	03rd May 2018
Med. Exam valid up to	27th May 2019
FRT0 License	Valid
Date of issue	16th June 2014
Valid up to	15th June 2019
IR test done	25th Dec 2018
IR test due	24th Dec 2019
Total flying experience	2999:39 Hrs
Experience on type	2707:30 Hrs
Experience as PIC on type	N/A
Last flown on type	A320
Total flying experience during last 180 days	434:09 Hrs

Total flying experience during last 90 days	157:23 Hrs
Total flying experience during last 30 days	63:48 Hrs
Total flying experience during last 07 Days	21:49 Hrs
Total flying experience during last 24 Hours	09:13 Hrs

## 1.6 Aircraft Information

### 1.6.1 Airbus A-320 NEO

The Airbus A320 is narrow-body (single-aisle) aircraft with a retractable tricycle landing gear and is powered by two wing pylon-mounted turbofan engines. The A320 family aircraft fitted with new engines were named as NEO (New Engine Option) and the rest were named as CEO (Current Engine Option). These new engines were manufactured with the idea that it will consume less fuel as compared to other engines, reduced CO2 emissions and reduction in engine noise. A320 NEO can be fitted with either:

- The PW1127G-JM, manufactured by Pratt & Whitney or;
- The LEAP-1A, manufactured by CFM International.

The A320 NEO aircraft made its first flight on 25th September 2014 and it was first introduced by Lufthansa on 20th January 2016. A total of 38 operators worldwide are operating A320 NEO family aircraft. After acceptance of Type Certification by DGCA, these A320 NEO aircraft (fitted with PW1127G-JM engines) were inducted by two airline operators in India i.e. M/s Indigo and M/s Go Air.

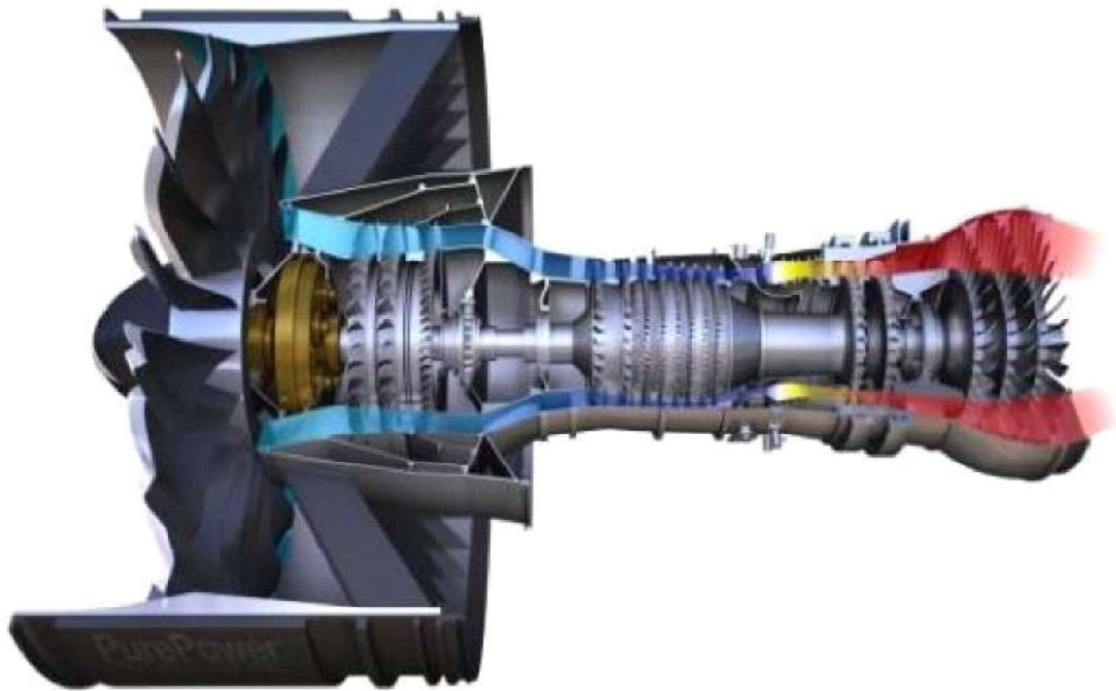
M/s Indigo inducted the first A320 NEO aircraft in its fleet on 11th March 2016. The number of A320 NEO family fleet operating in India and globally (as of November 2020) is given below: -

	Airlines	A320 NEO		A321 NEO		Total
Global (Including India)	All	485		249		734
India	Indigo	115	161	25	25	186
	Go Air	46		0		

**Table 1: A320/A321 Neo fleet Global vs India.**

### 1.6.2 Brief Technical Description of PW1127G-JM Engine

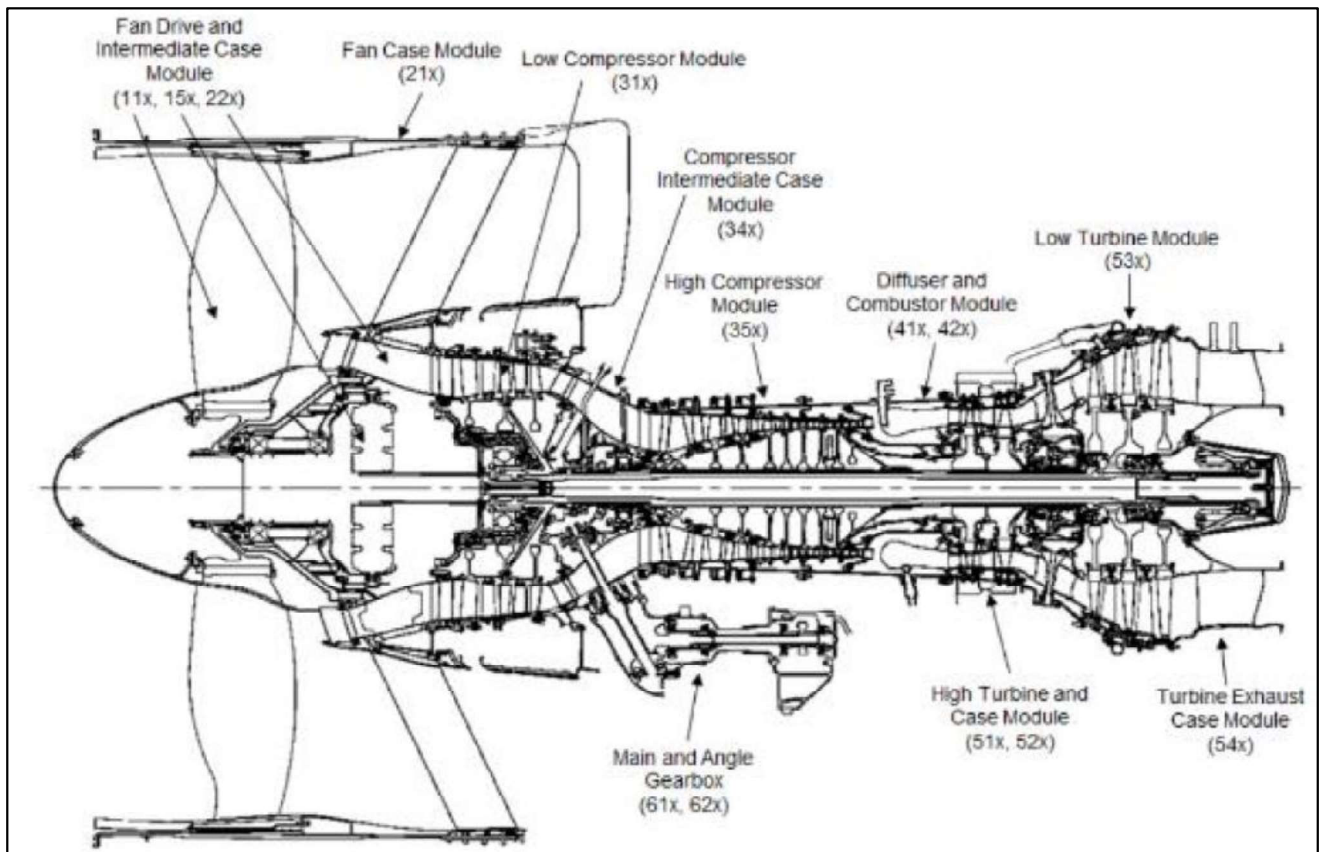
The PW1127G-JM turbofan engine is an axial-flow, twin spool turbofan engine with an ultra-high bypass ratio, low speed gear-driven fan.



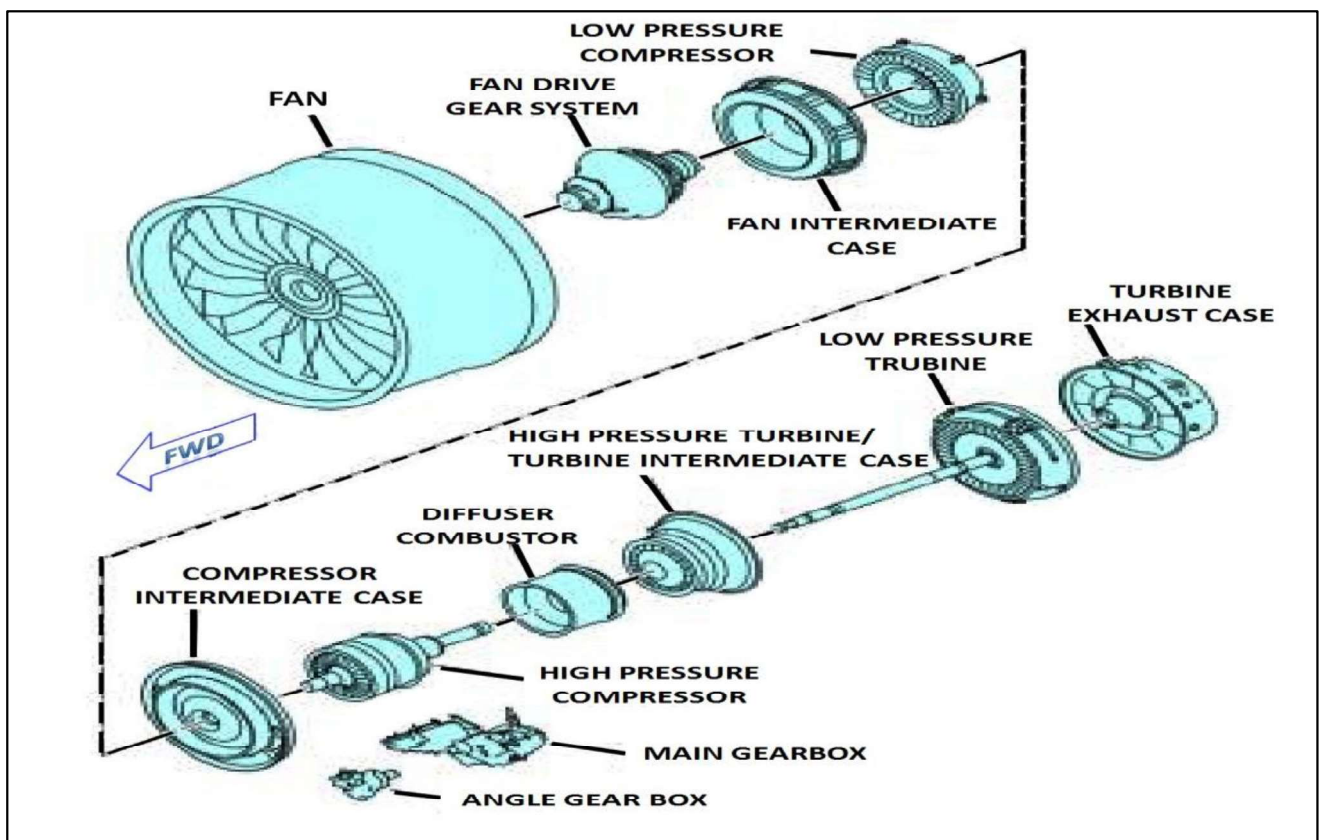
**Figure 1: ENGINE CROSS SECTION**

The engine comprises of Modules/Build Groups as shown below: -

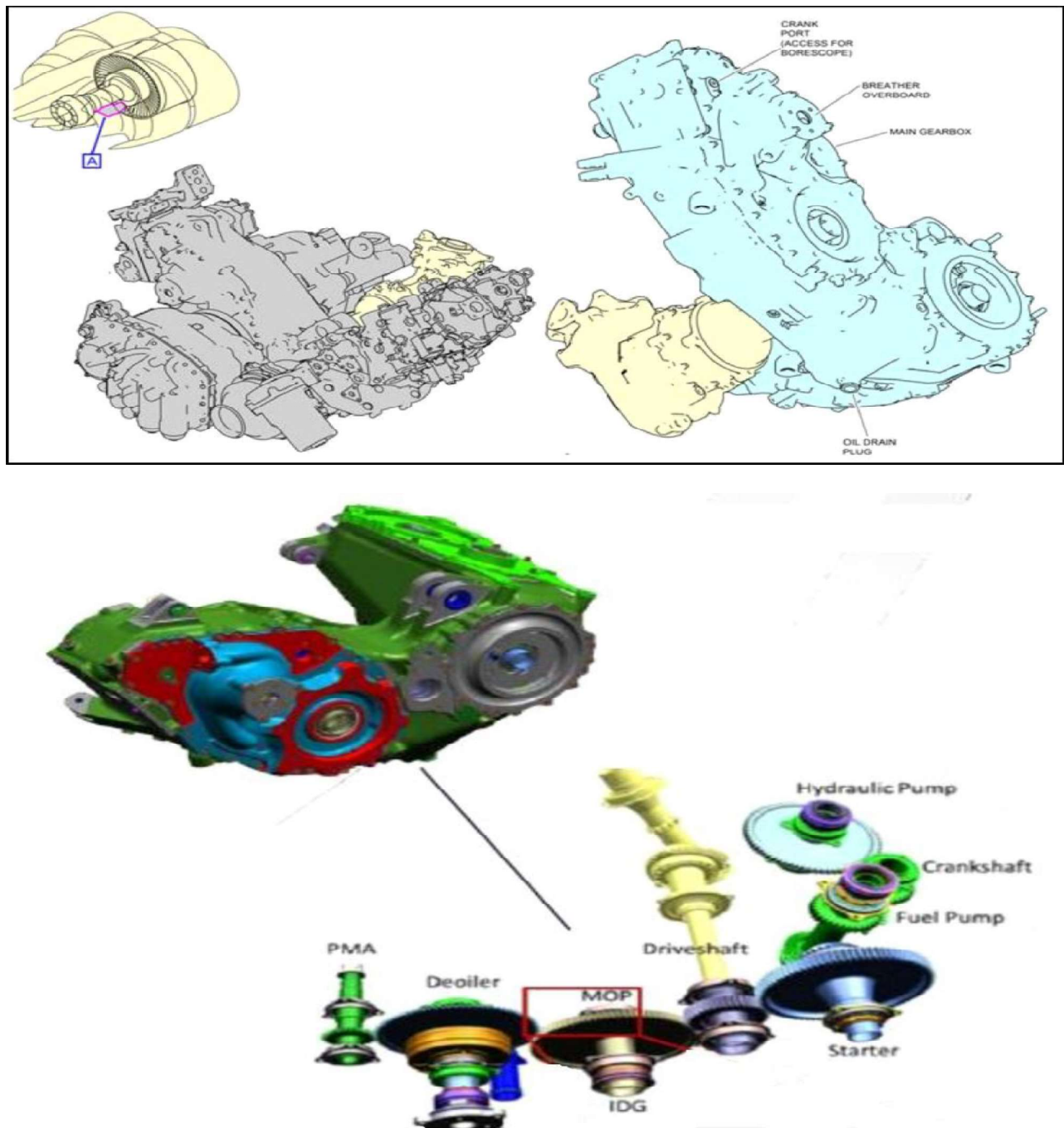
1. Fan Rotor Group	13. High Compressor Front Case Group
2. Fan Drive Bearing Group	14. High Compressor Rotor Group
3. Fan Drive Gear Group	15. Diffuser Case Group
4. Fan Intermediate Case Group	16. Combustor and Turbine Nozzle Group
5. No. 2 Bearing Group	17. High Turbine Stator Group
6. Fan Case Group	18. High Turbine Rotor Group
7. Low Compressor Stator Group	19. Turbine Intermediate Case Group
8. Low Compressor Rotor Group	20. Low Turbine Stator Group
9. 2.5 Bleed Group	21. Low Turbine Rotor Group
10. Compressor Intermediate Case Group	22. Turbine Exhaust Case Group
11. No. 3 Bearing Group	23. Main Gearbox Group
12. High Compressor Rear Stator Group	24. Angle Gearbox Group



**Figure 2: Engine Modules/ Build Group**



**Figure 3: Engine Modules/ Build Group**



**Figure 4: MGBG – Main Gear Box Group**

### 1.6.3 Aircraft VT-WGT General Information

Aircraft Model	A320-271N
Aircraft S. No.	8382
Year of Manufacturer	2018
Name of Owner	M/s GY AVIATION LEASE 1730 CO. LIMITED
C of R	4952
C of A	7055



Category	NORMAL
C of A Validity	16.09.2019
A R C issued on	17.09.2019
ARC valid up to	16/09/2019
Aircraft Empty Weight	42,388 Kg
Maximum Take-off weight	73,500 Kg
Date of Aircraft weighment	24/08/2018
Empty Weight	43,301 Kg
Max Usable Fuel	18,622 Kg
Max Pay load with full fuel	11,577 Kg
Empty Weight C.G	18.91 mts aft of datum
Next Weighing due	23/08/2023
Total Aircraft Hours	1897:35
Last major inspection	'2A' CHECK done on 16/01/2019 at 1376:41 hrs / 695 Cycles
Engine Type	PW1127GA-JM
Date of Manufacture LH	03/06/2019
Engine Sl. No. LH	P 770-792
Last major inspection (LH)	'2A' CHECK done on 16/01/2019 at 1376:41 hrs / 695 Cycles
Total Engine Hours/Cycles LH	1897:35 / 1002
Date of Manufacture RH	04/06/2019
Engine Sl. No. RH	P 770-794
Last major inspection (RH)	'2A' CHECK done on 16/01/2019 at 1376:41 hrs / 695 Cycles
Total Engine Hours/Cycles RH	1897:35 / 1002
Aeromobile License	31/01/2023

All concerned Airworthiness Directives, mandatory Service Bulletins, and DGCA Mandatory Modifications on this aircraft and its engines were complied with as on date of event.

## 1.7 Meteorological Information

Weather has no relevance to the subject incident.



## **1.8 Aids to Navigation**

All Navigational Aids available at Lucknow airport were serviceable. The aircraft was equipped with standard navigational equipment and there was no recorded defect with the navigational equipment prior to the flight.

## **1.9 Communications**

There was always a positive two-way communication between the aircraft & ATC.

## **1.10 Aerodrome Information**

Chaudhary Charan Singh International Airport is located in City of Lucknow. It is operated by Adani Lucknow International Airport Limited. The IATA Location Identifier Code is LKO and ICAO Location Indicator Code is VILK. Airport Co-ordinates and elevation are as below:-

Lat	:	26° 45' 43" N
Long	:	080° 53' 00" E.
Elevation	:	404 feet (237 meters).

The airport has three runways with orientation 09/27.

## **1.11 Flight Recorders**

Both Solid State Cockpit Voice Recorder (SSCVR) and Solid-State Flight Data Recorder (SSFDR) were downloaded and readout was carried out. Relevant data was used for analysis and correlating with other evidences.

## **1.12 Wreckage and Impact Information**

Not applicable as the damages were confined to Main Gear Box (MGB) of Engine # 1 only.

## **1.13 Medical and Pathological Information**

The crew had undergone pre-flight medical including BA (Breath Analyzer) Test as per requirements. The test result was negative.

#### **1.14 Fire**

There was no fire.

#### **1.15 Survival Aspects**

The incident was survivable.

#### **1.16 Test and Research**

Nil

#### **1.17 Organizational and Management Information**

The aircraft was operated by an Indian registered scheduled airline, M/s Go Airlines (India) Limited, which was one of the launch customers for the Airbus A320 NEO aircraft fitted with PW1127G-JM engines. It operates scheduled flights to both domestic and international sectors. The A320 family aircraft operated by M/s Go Air are fitted with engines manufactured by Pratt & Whitney, USA. As of November 2020, M/s Go Air has a total fleet of 46 A320 Neo aircraft.

#### **1.18 Additional Information**

##### **1.18.1 Typical Snags Reported in PW1127G-JM Engines and Rectifications/ Modifications.**

Since the induction of PW1127G-JM engines in India in the year 2016, there had been a number of snags reported. Most of the snags were repetitive in nature. In order to prevent reoccurrence of such failures, Pratt & Whitney came up with some rectification actions/Modifications for each snag.

Some of the typical snags reported are as follows: -

- #3 bearing seal failure.
- Combustor failure.
- Low Pressure Turbine (LPT) failure.
- N2 Vibration.
- Main Gear Box (MGB) Integrated Drive Generator (IDG)/LSOP (Lube & Scavenge Oil Pump) gear failure.

Following table depicts the Rectification Action/Modification carried out by Pratt & Whitney for each of the above Failures: -

S. No.	Typical Snag Reported	Rectification Action proposed by P&W
1.	# 3 bearing seal failure	Issued SB 72-00-087
2.	Combustor failure	Issued SB 72-00-0136
3.	Low Pressure Turbine failure	Issued SB 72-00-0111
4.	N2 Vibration	SB 72-00138 was released to replace HPC stage 6 ring seal with modified one.
5.	MGB IDG/LSOP gear failure.	Issued SB 72-00-0129

**Table 2: Typical Engine Failures and Rectification Action by Pratt & Whitney.**

The typical engine failures discussed in above para led to significant occurrences like In-Flight Shut Down (IFSD), Air Turn Back (ATB), Ground Turn Back (GTB), Rejected Take-Off (RTO), etc. The type and number of occurrences (Involving Indigo & Go Air aircraft) corresponding to each of the typical engine failures are listed below: -

<b>Type of Failure</b> →	#3 bearing seal failure	Combustor failure	LPT failure	N2 Vibration	MGB IDG/LSOP gear failure.
<b>Type of Event</b> ↓					
<b>RTO (Rejected Take-off)</b>	Nil	1	Nil	2	Nil
<b>Engine Stall</b>	Nil	Nil	1	Nil	Nil
<b>ATB (Air Turn Back)</b>	Nil	1	18	5	3
<b>GTB (Ground Turn Back)</b>	Nil	Nil	Nil	1	Nil
<b>Diversion</b>	Nil	Nil	6	1	1
<b>Emergency Landing</b>	1	Nil	Nil	Nil	Nil

**Table 3. Type of Occurrences corresponding to each engine failure.**

Out of the significant occurrences mentioned in the table above, 18 occurrences were classified as serious incidents by AAIB and Annex 13 investigation were instituted to investigate these serious incidents. Further distribution of these 18 serious incidents corresponding to type of failure is as below: -

Type of Failure	Number of Serious Incidents
# 3 bearing seal failure	01
LPT failure	15
N2 Vibration	01
MGB IDG/LSOP gear failure.	01

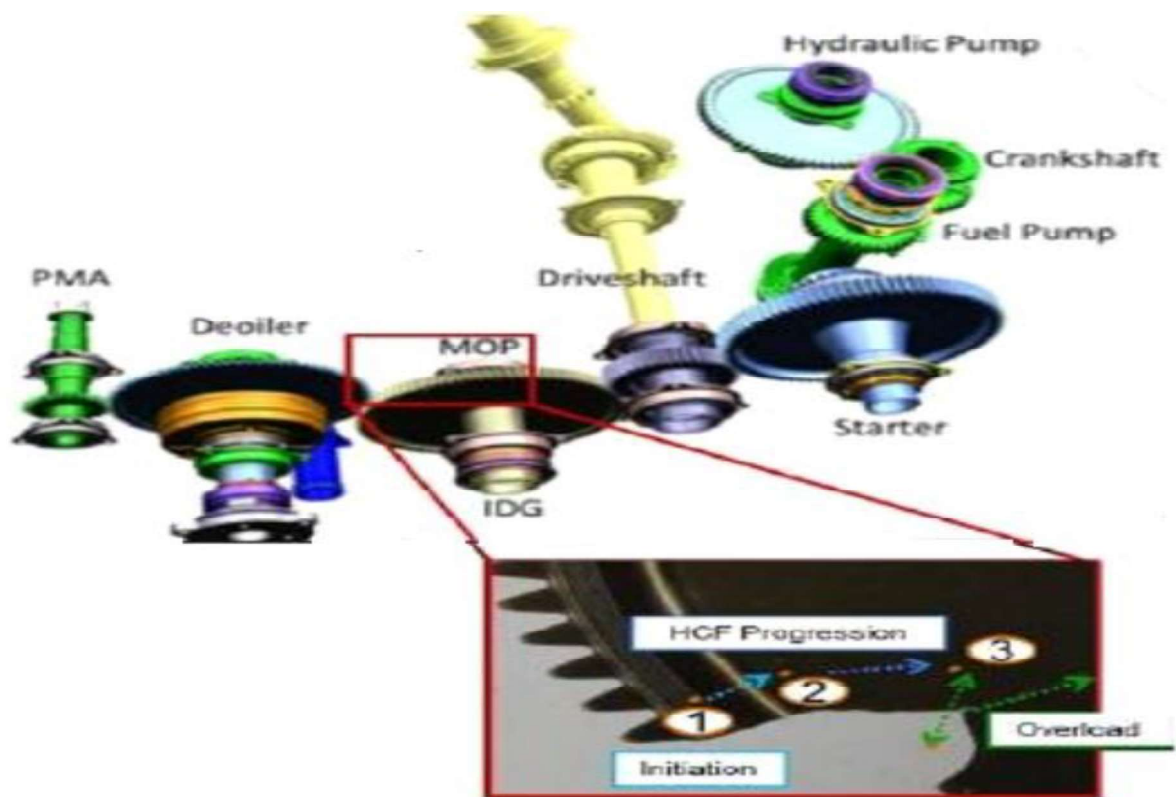
**Table 4. Number of serious incidents corresponding to type of failures.**

### 1.18.2 Rectification Action carried out for MGB IDG/LSOP gear failure.

Engine Sr No. 770792 was inducted at OEM facility for disassembly, inspection and repair. The IDG gear shaft was found fractured with secondary damage throughout the Main Gearbox. The Main Gearbox was found with the MOP/IDG Gear fractured. The Main Gearbox was rebuilt to incorporate SB 72-00-0129 in order to address this failure mode.

In Preliminary Observation Report of the occurrence, data of similar occurrences worldwide since October 2018 till the date of occurrence was analyzed and is given below: -

- There were 08 IFSD events/ 02 on-ground events.
- Issue presents as Low Oil Pressure ECAM warning.
- All 08 IFSD events were confirmed to have fractures of the Main Oil Pump (MOP).



**Figure 5 : Fractured MOP/IDG Gear**

In the report, P&W came up with a corrective action plan to eliminate reoccurrence of such types of failure in future. The said report also mentioned that the fractured MOP/IDG Gear is consistent with other AGB events. The report said that the root cause investigation has involved both rig and engine testing. This revealed that crack initiation in the MOP/IDG gear has been linked to vibratory excitation of MOP/IDG gear under certain engine operating conditions. Following Corrective Action Plan, was given to reduce event frequency: -

- Engine Software (FCS 5.0) with keep-out zones at certain N2 speeds.
- On-wing retrofit with redesigned MOP/IDG gear to avoid vibratory response.

Service Bulletin (PW SB 72-00-0129) on “Engine – Gear shaft, Integrated Drive Generator (IDG), Oil Pump Drive, Assembly - Replace the IDG Oil Pump Drive Gear shaft Assembly to Improve Main Gearbox Durability” was issued, to eliminate the re-occurrence of IFSD events and obviate fracture of MOP/IDG gear fracture. The reason for issue of this SB was given as “The IDG oil pump drive gear shaft assembly can fracture during engine operation resulting in an IFSD. The cause of failure was given as “Resonance response of some IDG oil pump drive gear shaft assemblies to certain engine operating conditions result in a high cycle fatigue fracture.”

The SB required to replace the IDG oil pump drive gear shaft assembly with an improved IDG oil pump drive gear shaft assembly with an axially thicker gear web, a radially thicker gear rim, and improved tooth tip relief to eliminate the resonance response of the IDG oil pump drive gear shaft assembly during engine operation. It was also mentioned that the subject SB was the terminating action for the problem.

Airbus SB 73-1136 titled “Engine Fuel and Control - FADEC System - Introduce FCS5.0 FADEC Software on NEO PW” was also introduced. The purpose of this Service Bulletin is to introduce a new FADEC standard (STD) FCS5.0 (EEC and PHMU) on PW1100G-JM engines. The FCS5.0 software addresses specific items and provides additional software improvements on EEC and PHMU with respect to overall software robustness.

M/s Go Air has carried out the task as per the above said SBs and as on date, all their serviceable PW1127G-JM engines are complied with both SBs. No similar occurrence has been reported in India since the compliance of these SB issued by Pratt & Whitney and Airbus.

## **1.19 Useful or Effective Investigation Techniques**

Nil

## **2 ANALYSIS**

### **2.1 General**

- Both operating crew were appropriately licensed and qualified to operate the flight.
- The aircraft had a valid Certificate of Airworthiness at the time of incident. The Aircraft held a valid Certificate of Release to Service which was issued at the airport of departure. Airworthiness Directives & Service Bulletins were complied with. Transit Inspections were carried out as per the approved Transit Inspection Schedules and all higher Inspection Schedules including checks/inspection as per the manufacturer's guidelines and specified in Maintenance Programme were carried out as and when due.

### **2.2 Circumstances Leading to the Incident**

While cruising at an altitude of 38,000 feet 'ENG 1 Oil CHIP DETECTED' was triggered on ECAM which was followed by 'ENG 1 FADEC SYS FAULT, ENG1 FADEC ALTERNATOR, ENG1 FADEC' and 'ENG1 HEAT SYS FAULT on ECAM'. Subsequently, 'ENG1 LO PR' (Engine # 1 Low Oil Pressure) also triggered on ECAM. The engine oil pressure was found reducing below 100 and was reduced to 2 within 05 seconds. The Engine # 1 power was immediately brought back to idle by crew. Thereafter, 'ENG1 FAIL' triggered on ECAM. The crew carried out ECAM actions and subsequently carried out commanded IFSD of Engine # 1.

As the Engine parameters were abnormal and the engine # 1 was Shut Down, the crew decided to divert to Lucknow. 'Land ASAP' Amber also came ON. The aircraft at that time was in Varanasi FIR. The crew declared 'PAN PAN' due one engine failure to ATC, Varanasi. ATC, Varanasi instructed aircraft to descend to lower level (FL240). The aircraft was then changed over to ATC, Lucknow. After obtaining necessary clearances from ATC, Lucknow the aircraft landed uneventfully with single engine at Lucknow.

Oil quantity of ENG # 1 was found to be 2 quarts which was 20 quarts at the beginning of flight. The consumption during the sector was abnormal. Oil traces were found on exhaust nozzle, tail cone, drain mast and TR cowl area underneath drain mast.

Metal particles were observed on ENG # 1 MGB chip collector. The involved engine (ENG # 1) was removed from the aircraft for further detailed examination and aircraft released for further flight operations.

During Disassembly and Inspection of the engine carried out by OEM, it was observed that the IDG oil pump drive gear shaft assembly fractured during engine operation. It was

opined by the OEM that the resonance response of some IDG oil pump drive gear shaft assemblies to certain engine operating conditions can result in a high cycle fatigue fracture.

This fracture of IDG oil pump drive gear shaft assembly and consequent damages to other MGB components like PMA, Starter Drive, Deoiler, Hydraulic pump etc. led to improper scavenging and insufficient air sealing. This resulted in various ECAM fault including Engine Oil low pressure and subsequently to engine failure and IFSD (Commanded).

### **2.3 Preventive Actions taken by OEM & Operator**

It was observed that the failure of MOP/IDG gear was because of its resonance response to certain engine operating conditions which resulted in a high cycle fatigue fracture.

The OEM came up with an immediate as well as long-term corrective action plan to arrest such failing. To eliminate the re-occurrence of IFSD events and obviate fracture of MOP/IDG gear fracture, Service Bulletin (PW SB 72-00-0129) on “Engine – Gear shaft, Integrated Drive Generator (IDG), Oil Pump Drive, Assembly - Replace the IDG Oil Pump Drive Gear shaft Assembly to Improve Main Gearbox Durability” was also issued. The SB required to replace the IDG oil pump drive gear shaft assembly with an improved IDG oil pump drive gear shaft assembly.

The new and improved IDG oil pump drive gear shaft assembly has an axially thicker gear web, a radially thicker gear rim, and improved tooth tip relief to eliminate the resonance response of the IDG oil pump drive gear shaft assembly during engine operation. It was also mentioned that the subject SB was the terminating action for the problem.

Further, Airbus SB 73-1136 titled “Engine Fuel and Control - FADEC System - Introduce FCS5.0 FADEC Software on NEO PW” introduced a new FADEC standard (STD) FCS5.0 (EEC and PHMU) on PW1100G-JM engines.

Both SBs have been complied by M/s Go Air on all its serviceable PW1127G-JM engines and no similar occurrence has been reported in India since the compliance of these SBs.

## **3 CONCLUSION**

### **3.1 Findings**

1. The Certificate of Airworthiness, Certificate of Registration and the Certificate of Flight Release of the aircraft was valid on the date of incident and all concerned Airworthiness Directives, Service

Bulletins, DGCA Mandatory Modifications on this aircraft and its engines were found complied with.

2. No snag was reported by the crew on the flights prior to the incident flight on the day of incident.
3. Both pilots were appropriately qualified to operate the flight.
4. Due to warnings that triggered on ECAM and abnormal Engine parameters the Engine # 1 was Shut Down and the crew decided to divert to Lucknow.
5. The crew declared 'PAN PAN' due one engine failure to ATC, Varanasi. ATC, Varanasi instructed aircraft to descend to lower level (FL240). The aircraft was then changed over to ATC, Lucknow. After obtaining necessary clearances from ATC, Lucknow the aircraft landed uneventfully with single engine at Lucknow.
6. During post flight inspection Oil quantity of Engine # 1 was found to be 2 quarts which was 20 quarts at the beginning of flight. The consumption during the sector was abnormal. Oil traces were found on exhaust nozzle, tail cone, drain mast and TR cowl area underneath drain mast. Metal particles were observed on Engine # 1 MGB chip collector.
7. On further inspection of AGB/MGB, Main Oil Pump (MOP)/ Integrated Drive Generator (IDG) Gear was found damaged.
8. There was no fire and no injury to any occupant on board the aircraft.
9. During the "Tear Down Inspection" at OEM facility, it was observed that the IDG oil pump drive gear shaft assembly fractured during engine operation.
10. Based on analysis of earlier events it was opined by the OEM that the resonance response of some IDG oil pump drive gear shaft assemblies to certain engine operating conditions can result in a high cycle fatigue fracture.
11. This fracture of IDG oil pump drive gear shaft assembly and consequent damages to other MGB components like PMA, Starter Drive, Deoiler, Hydraulic pump etc. led to improper scavenging and insufficient air sealing. This resulted in various ECAM fault including Engine Oil low pressure and subsequently to engine failure and IFSD (Commanded).
12. To eliminate the re-occurrence of such events and PW SB 72-00-0129 and Airbus SB 73-1136 were issued.
13. M/s Go Air has carried out the task as per the above said SBs and as on date, all their serviceable PW1127G-JM engines are complied with these SBs. No similar occurrence has been reported in India since the compliance of these SBs.

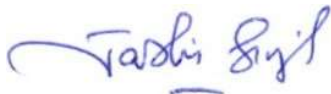


### **3.2 Probable Cause of the Incident**

The IDG oil pump drive gear shaft assembly fractured during engine operation as its resonance response to certain engine operating conditions resulted in a high cycle fatigue fracture. This fracture of IDG oil pump drive gear shaft assembly and consequent damages to other MGB components resulted in various ECAM fault including Engine Oil low pressure and subsequently to engine failure and IFSD (Commanded).

## **4 SAFETY RECOMMENDATIONS**

Corrective Actions initiated by the OEM and subsequent compliance by the operator has been adequate to obviate recurrence hence nil recommendation is made.



**Jasbir Singh Larhga**  
**Investigator - In - Charge**



**K Ramachandran**  
**Investigator**