FINAL INVESTIGATION REPORT
ON
SERIOUS INCIDENT TO M/S INDIGO AIRBUS A320(NEO) AIRCRAFT VT-ITR AT KOLKATA ON 10th DECEMBER 2018

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
AMSL	Above Mean Sea Level
ARC	Airworthiness Review Certificate
ASR	Airport Surveillance Radar
ATC	Air Traffic Control
AUW	All Up Weight
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CAR	Civil Aviation Requirements
CPL	Commercial Pilot License
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DGCA	Directorate General of Civil Aviation
F/O	First Officer
FCOM	Flight Crew Operating Manual
FCTM	Flight Crew Training Manual
FRTOL	Flight Radio Telephone Operators License
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
LLZ	Localizer
MEL	Minimum Equipment List
MLG	Main Landing Gear
MTOW	Maximum Take Off Weight
NDB	Non-Directional Beacon
NLG	Nose Landing Gear
NM	Nautical Miles
PA	Passenger Address
PF	Pilot Flying
PIC	Pilot in Command
PM	Pilot Monitoring
QRH	Quick Reference Handbook
RA	Radio Altitude
RESA	Runway End Safety Area
SB	Service Bulletin
SEP	Safety and Emergency Procedures Manual
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
VOR	VHF Omnidirectional Range
UTC	Coordinated Universal Time

FINAL INVESTIGATION REPORT ON SERIOUS INCIDENT TO M/S INDIGO AIRBUS A320 (NEO) AIRCRAFT VT-ITR AT KOLKATA ON 10/12/2018

1.	**Aircraft Type**	**:**	Airbus A320-271 NEO
	Nationality	**:**	Indian
	Registration	**:**	VT - ITR
2.	**Owner**	**:**	Inter Globe Aviation Ltd (IndiGo)
3.	**Operator**	**:**	Inter Globe Aviation Ltd (IndiGo)
3.	**Pilot – in –Command**	**:**	ATPL holder
	Extent of Injuries	**:**	Nil
4.	**First Officer**	**:**	CPL Holder
	Extent of injuries	**:**	Nil
5.	**Place of Serious Incident**	**:**	Kolkata Airport
6.	**Date & Time of Incident**	**:**	10th Dec 2018 & 1640 UTC
7.	**Last Point of Departure**	**:**	Jaipur Airport
8.	**Point of Intended Landing**	**:**	Kolkata Airport
9.	**Latitude/Longitude**	**:**	22°39'17" N / 088° 26' 48" E
10.	**Type of Operation**	**:**	Scheduled Operation
11.	**Passengers on Board**	**:**	139
	Extent of Injuries	**:**	Nil
12.	**Phase of Operation**	**:**	Descend
13.	**Type of Occurrence**	**:**	Emergency Landing due to Smoke

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

SYNOPSIS

On 10th December 2018, M/s Indigo Airbus A320-271 (NEO) aircraft VT-ITR, while operating a scheduled flight (flight No. 6E-237) from Jaipur to Kolkata was involved in a Serious Incident of emergency landing at Kolkata due to smoke in cockpit & cabin.

The aircraft was under the command of an ATPL holder who was Pilot Flying (PF) with a co-pilot a CPL holder who was Pilot Monitoring (PM). There were 139 passengers on board the aircraft including 06 cabin crew members.

The aircraft took –off from Jaipur. While descending into Kolkata airport, one of the Cabin Crew observed smoke in aft right lavatory, the same was informed to PIC. Later, ECAM warning for Lavatory Smoke and Avionics Smoke came in the cockpit. During approach, Crew declared MAY DAY due to Smoke to ATC Kolkata. Aircraft made an emergency landing at Kolkata Airport and subsequently, it was taken to isolation bay. Passengers were evacuated safely, by using escape slide and step ladder.

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 10th December 2018, M/s Indigo Airbus A320-271 (NEO) aircraft VT-ITR, while operating a scheduled flight (flight No. 6E-237) from Jaipur to Kolkata was involved in a Serious Incident of smoke in cockpit &cabin. The aircraft carried out an emergency landing at Kolkata.

Prior to the incidented flight, the aircraft had operated 06 flights. There was no abnormality reported on the aircraft during these flights. The aircraft then took-off from Jaipur at around 1517UTC. The en-route flight was uneventful. During descent into Kolkata, at about 1643 UTC, the cabin crew reported to cockpit crew that there was smoke in the cabin. The cabin crew had tried to find out the source of smoke. Though the cockpit crew though felt some pungent smell in the cockpit, however, there was no ECAM message to that effect. The cabin crew, in the mean time informed cockpit crew that they were not able to identify the source of smoke but the cabin was still smoky.

At about 1645 UTC, when the aircraft was descending through FL 210, the cabin crew informed cockpit crew that the smoke in the cabin was getting denser. The cockpit crew also observed smoke in cockpit and subsequently switched ON Ventilation/Blower. While descending through FL 170, the flight crew got ECAM warning for LAVATORY SMOKE.

The aircraft came in contact with ATC Kolkata (Approach) at 1647 UTC. At 164751 UTC, the crew requested for priority landing which was approved by the Approach Control. Thereafter, at 164814 UTC, FWD & AFT CARGO SMOKE warnings were observed in the cockpit, followed by AVIONICS SMOKE. At 164833 UTC, when the aircraft was at 40 NM west of Kolkata, the cockpit crew declared “MAY DAY” due to smoke. The Approach Control then reconfirmed with cockpit crew about the smoke for which they informed smoke in cabin, lavatory and cockpit.

The aircraft was vectored by the shortest path by the Approach Control. The crew followed QRH procedure and thereafter carried out landing checklist. At 165841 UTC, when the aircraft was 6 miles from touchdown, it was handed over to Tower Control. At 165854 UTC, the aircraft came in contact with tower and was immediately given landing clearance for Rwy 01R.

On landing, the crew requested tower for isolation bay and requested that they require fire services as stand by. The same was affirmed by the Tower Control. Full emergency was declared at Kolkata airport and the aircraft landed safely at around 17:00 UTC. During final approach and till touchdown, the “Aural Warning for Smoke” got triggered intermittently in the cockpit.

Upon landing, the aircraft vacated the runway to isolation bay i.e. secondary runway 01L dumbbell. The cockpit crew after reaching secondary runway 01L dumbbell informed Ground Control that they want to disembark passengers at this position itself before opening the cargo door. The flight crew reconfirmed if runway 01L dumbbell is the isolation bay. The same was confirmed by the Ground Control. The cabin crew disarmed slides normally to open all doors.

While waiting for disembarkation ladders to arrive, L2 and R2 cabin crew closed L2 and R2 doors to rearm slides and then deployed the slides. Evacuation of passengers was initiated from rear exits, though there were no instructions from the cockpit crew.

The forward passengers disembarked from the front doors with the use of ladders. There was no injury to any of the occupant on board the aircraft.

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	NIL	NIL	NIL
Serious	NIL	NIL	NIL
~~**Minor**~~**/ None**	02+04	149	NIL

1.3 Damage to Aircraft

Barring, minor damages confined to core of engine # 2, there were no damages to the aircraft during the occurrence. The teardown inspection of the engine was carried out at Columbus Engine Centre (CEC), USA to assess the damages in view of smoke/ smell in the cabin, high oil consumption and HPC oil wetness. A gate report was received from CEC and following are the relevant observations: -

- Carbon nose of the No. 3 Rear Carbon Seal was found missing (failed).
- Oil wetness was observed at all stages of High Pressure Compressor (HPC) Assembly.
- Liner cracks were observed in the Combustor Assembly though within 1500 hrs. re-inspect limits.

- Excessive burning was observed on HPT1 Blades.
- Crack observed in the composite material of the Inlet Cone.
- V-groove of Fan Case Assembly were found worn out.
- LPC Rear Case Assembly Inserts found failed.
- 2.5 Bleed Valve Seal was damaged.
- The No. 3 Rear Carbon Seal was found with total carbon nose failure. The Rear Seal Seat had corresponding wear at the hard face.
- Boroscope inspection of AGB revealed chucks of carbon nose material in the upper compartment.

1.4 Other Damage

Nil

1.5 Personnel Information

1.5.1 Pilot – In – Command

Date of Birth	02/03/1966
License	ATPL 2571
Date of Issue	25/07/2016
Valid up to	24/07/2021
Date of Class I Med. Exam.	16/06/2018
Class I Medical Valid up to	19/06/2019
Date of issue FRTOL License	15/04/2017
FRTO License Valid up to	14/04/2022
Total flying experience	17114.30
Total flying experience on type	5516.46
Last Flown on type	09/11/2018
Total flying experience during last 1 year	846.14
Total flying experience during last 6 Months	450.28
Total flying experience during last 30 days	91.20
Total flying experience during last 07 Days	25.28
Total flying experience during last 24 Hours	06.06
Rest period before flight	25.17
Whether involved in Accident/Incident earlier	N/A
Latest Flight Checks and Ground Classes	Drills done on 17/06/2018
ALRC (Annual Line route check)	30/08/2018

1.15.2 Co-Pilot

Date of Birth	31/07/1990
License	CPL 11865
Date of Issue	19/10/2017
Valid up to	18/10/2022
Date of Class I Med. Exam.	31/05/2018
Class I Medical Valid up to	30/05/2019
Date of issue FRTOL License	19/10/2017
FRTO License Valid up to	18/10/2022
Endorsements as PIC	N/A
Total flying experience	1691.27
Total flying experience on type	1161.29
Last Flown on type	03/01/2017
Total flying experience during last 1 year	781.13
Total flying experience during last 6 Months	409.37
Total flying experience during last 30 days	62.07
Total flying experience during last 07 Days	20.34
Total flying experience during last 24 Hours	06.06
Rest period before flight	25.17
Whether involved in Accident/Incident earlier	N/A
Latest Flight Checks and AVSEC training	Current
ALRC (Annual line route Check)	15/06/2018

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 are powered by two wing pylon-mounted turbofan engines. The A320 neo (*neo* for *new engine option*) made its first flight on September 2014. Indigo had selected Pratt & Whitney engines for their aircraft.

The PW1127G-JM turbofan engine is an axial-flow, twin spool turbofan engine with an ultra-high bypass ratio, low speed gear-driven fan. The engine bearings support the weight of engine parts and permit one surface to roll over another with minimal friction and wear.

The weight of the parts is transmitted through balls or rollers that are contained by raceways.

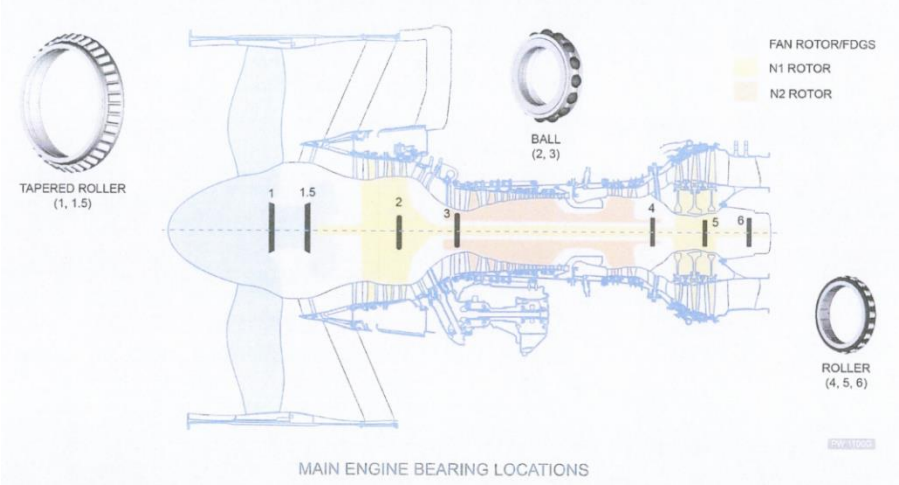
An axial load is transmitted parallel to the bearing shaft, and a radical load is applied perpendicular to the shaft. Bearings are lubricated, cooled, and cleaned by oil.

Engine Main Bearings

Five compartments contain a total of seven bearings. Details are as given below:

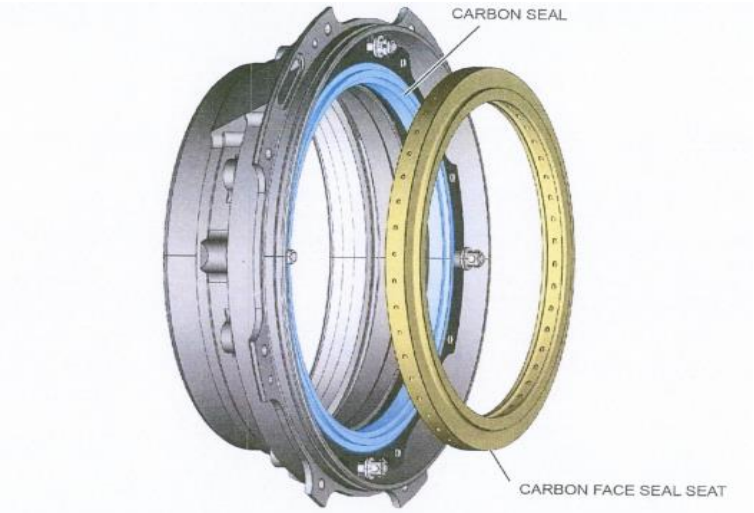
Bearing	Type	Support Function
1	Tapered roller	Fan rotor and Fan Drive Gear System
1.5		
2	Ball	Front of N1 rotor (LPC)
3		Front of N2 rotor (HPC)
4	Roller	Rear of N2 rotor (HPT)
5		Rear of N1 rotor (LPT)
6		

Oil damped bearings use a thin film of oil between the outer race and the bearing support to reduce vibration.



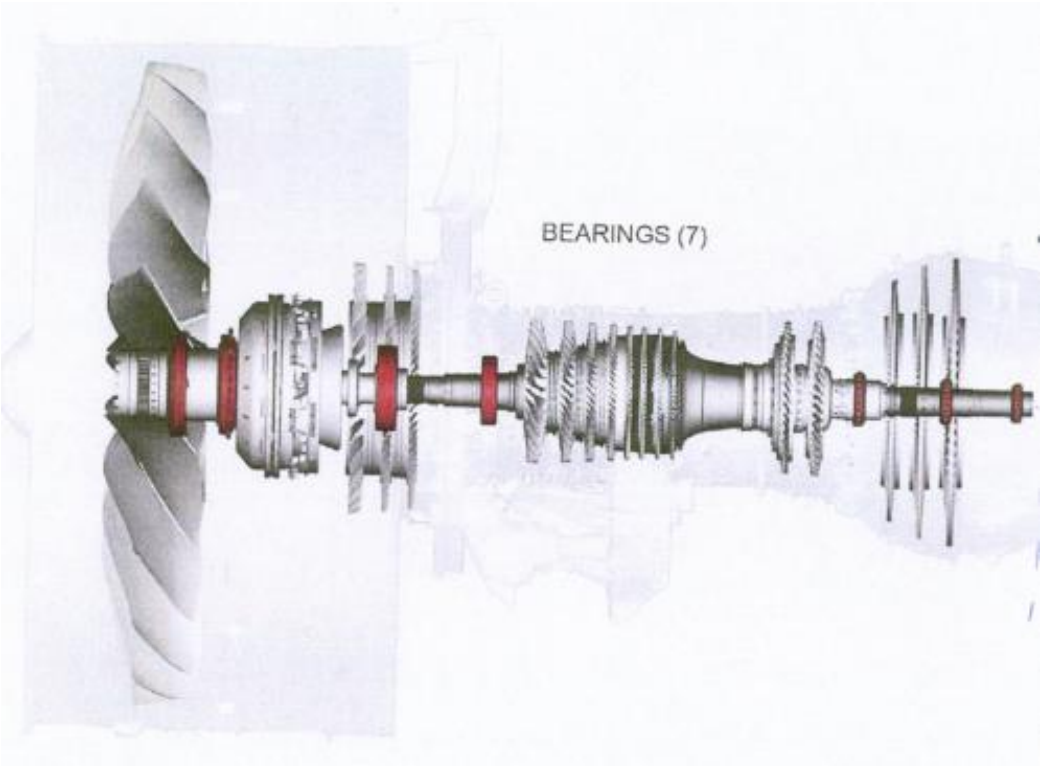
MAIN ENGINE BEARING LOCATIONS

Each compartment uses carbon seals to prevent oil leakage. The Carbon face seals seat axially against a rotating ring. Bearing no. 3 has a dry face seal. It is called dry face seal because the seal interface is not actively supplied with oil. The seal interface runs essentially dry except for inadvertent misting from inside the compartment.

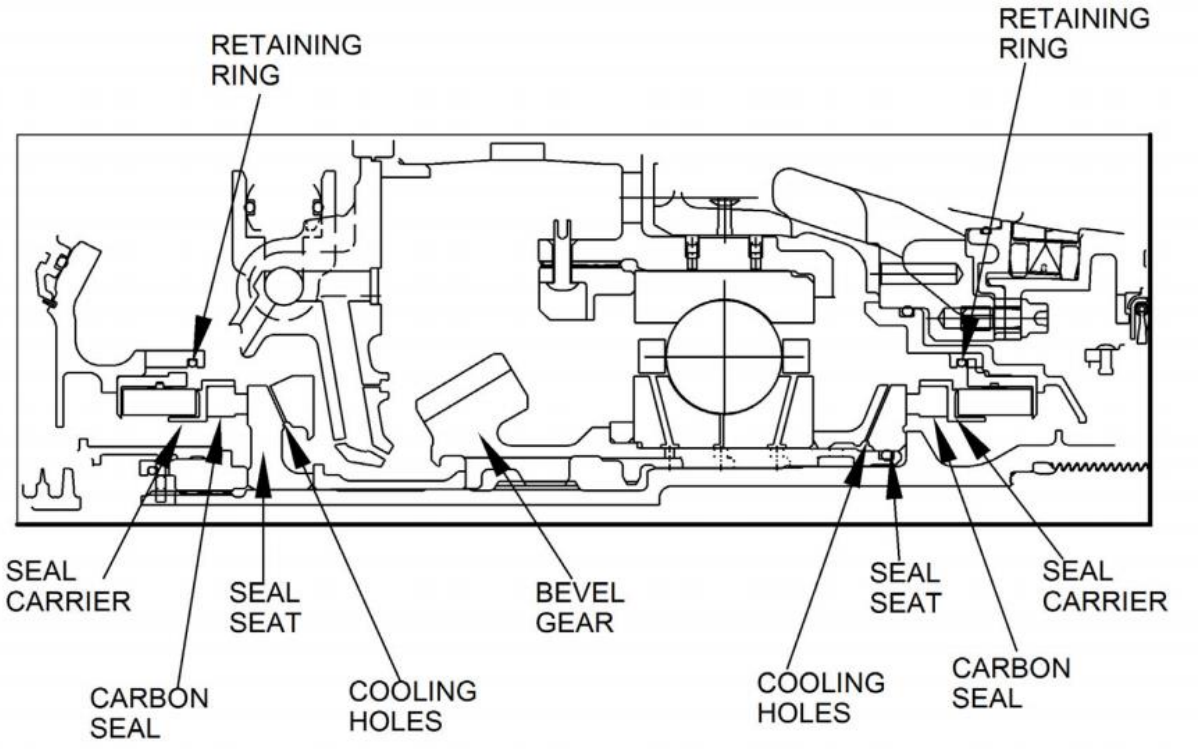


MAIN ENGINE BEARING COMPARTMENT HARDWARE

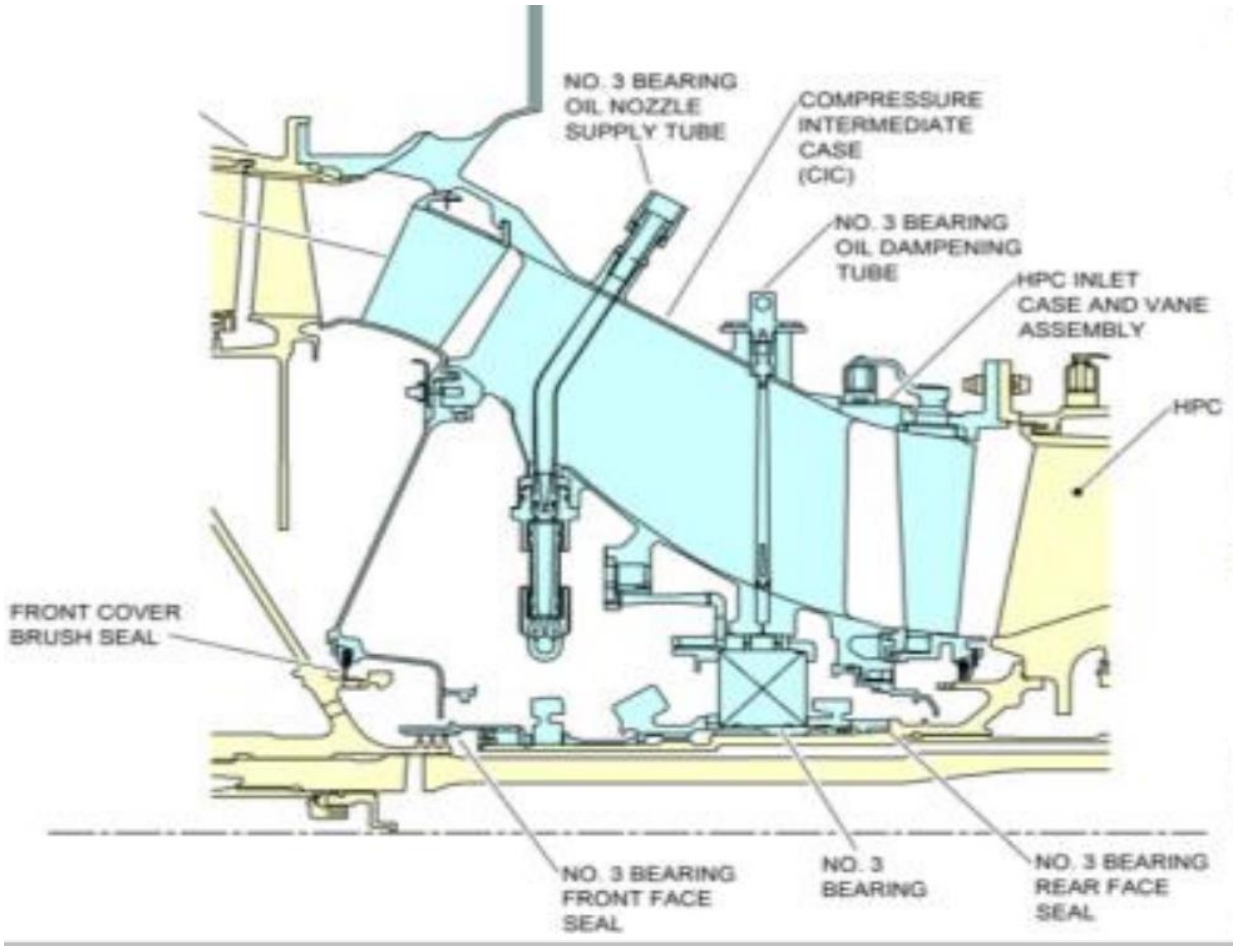
Each compartment has a scupper that returns any start-up leakage oil.



PRIMARY OIL-DEPENDENT COMPONENTS



Schematic Indicating of No. 3 Bearing Seals & Seats



Magnetic Chip Collectors

The Lubrication and Oil Scavenge Pump has six magnetic chip collectors. The collectors catch ferrous metal particles in the scavenge oil that are used to diagnose system problems. Five of the collectors are located on the LSOP and a sixth is found on the No. 4 Bearing scavenge return tube.

1.6.2 Aircraft VT-ITR General Information

Aircraft Model	AIRBUS A320-271N
Aircraft S. No.	7396
Year of Manufacturer	2017
Name of Owner	M/s Oriental Leasing 8 Company Ltd
C of R	4747/2
C of A	6850
Category	NORMAL
C of A Validity	NO VALIDITY
A R C issued on	23.03.2017
ARC valid up to	23.03.2019
Aircraft Empty Weight	39696.420 Kg
Maximum Take-off weight	73500.00 Kg
Empty Weight	39696.420 Kg
Max Usable Fuel	18622.00 Kg
Max Payload with full fuel	11519.665 Kg
Empty Weight C.G	23.930 % MAC
Next Weighing due	08.03.2022
Total Aircraft Hours	5491:03
Last major inspection on 10.11.18	3000 FH/ 3000 FC/ 360 DAYS
Engine Type	PW1127G-JM
Date of Manufacture LH	09.08.2018
Engine Sl. No. LH	P770813
Last major inspection on 10.11.18	3000 FH/ 3000 FC/ 360 DAYS
Total Engine Hours/Cycles LH	910/647
Date of Manufacture RH	16.09.2017
Engine Sl. No. RH	P770464
Last major inspection on 10.11.18	3000 FH/ 3000 FC/ 360 DAYS

Total Engine Hours/Cycles RH	2532/1657
All Applicable AD, SB & Modification were complied with.	

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.

1.6.3 Observations Made During Post Flight Inspection at Kolkata

Following are the significant observations made during post flight inspection of the aircraft: -

- Presence of Smokey odour in the cabin.
- No source of smoke observed in lavatory, avionics compartment or cargo compartments.
- Oil quantity of ENG # 2 was found to be 13 quarts, whereas 18 quarts of oil was available before the incidented flight.
- Engine run was carried out and smoke was observed in cabin with ENG # 2 running with packs on.
- Metal particles were observed on ENG # 2 chip collector.
- The involved ENG # 2 was removed from the aircraft and quarantined for further detailed examination.

1.7 Meteorological Information

As per MET Report of Kolkata airport (from 1530 UTC to 1800 UTC), the information was as follows: -

Time (UTC)	Wind Speed	Visibility(m)	Clouds	TREND
1630	000/00	2600	NSC	No SIG
1700	000/00	2600	NSC	No SIG
1730	000/00	2600	NSC	No SIG
1800	020/03	2400	NSC	No SIG

1.8 Aids to Navigation

All Navigational Aids available at Kolkata airport were serviceable.

1.9 Communications

At the time of incident, the aircraft was in contact with Kolkata Approach on frequency 127.9 MHz and then with tower. There was always a positive two-way communication between the aircraft& ATC (Approach & Tower).

1.10 Aerodrome Information

Netaji Subhash Chandra Bose International Airport is operated & Managed by Airports Authority of India. The IATA Location Identifier Code is CCU and ICAO Location Indicator Code is VECC.

Airport Co-ordinates: Lat : 22°39'17" N

Long : 88°26'48" E.

Elevation : 23 feet (7.01 meters).

The Airport Rescue and Fire Fighting Services is Category '9'

Runways				
Direction	Length	Width	App Lights/ ILS	Surface
01L/19R	3,190 m (10,498 ft)	46 m (151 ft)	CAT I / CAT II	Asphalt
01R/19L	3,627m (11,900 ft)	46 m (151 ft)	CAT III-B / CAT II	Asphalt

The secondary runway 01L dumbbell was used as isolation bay.

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.

1.11.1 Cockpit Voice Recorder

A total of last 03:12:47 hour of CVR recording was available.

Following are the salient observations of CVR recording: -

Relative Time	Call out between	Event
022759	Cabin Crew (CC) & cockpit	Cabin crew calls cockpit and informs that there is smoke in the cabin and they are trying to check the source.
022819	Intra Cockpit	Cockpit crew felt some Pungent smell in cockpit also.

022917	CC to Cockpit Crew	Cabin Crew informs that they are not able to locate the source of smoke and it continues to be smoky in the forward cabin.
023001		Cabin crew informs that the smoke is getting denser in the cabin and the passengers have started to feel uncomfortable
023152	Cockpit Crew	Cockpit Crew observed smoke in cockpit also and switched ON Ventilation /Blower.
023227	Crew to ATC	Cockpit crew requests ATC for Priority landing and the same was approved by ATC.
023250	Cockpit	"Aural Warning for Smoke" was heard in cockpit
023309	Pilot to ATC	Cockpit Crew made MAY DAY call due to smoke
023442	Cockpit	"Aural Warning for Smoke" was heard in cockpit
023917	Cockpit	Cockpit crew discussing that there is no fire but the smoke is very dense.
023923	Cockpit	Auto callout of 2500 ft was heard in the cockpit.
024300	Cockpit crew	"Aural Warning for Smoke" was heard in cockpit. The crew starts carrying out Landing Checklist
024320	Cockpit	"Aural Warning for Smoke" was heard in cockpit.
024409	Crew & ATC	Crew requests ATC for isolation bay and informs that they require all fire equipment.
024434	Cockpit/Cockpit Crew	Auto callout of 1000 was heard in the cockpit. Crew carried out Touchdown Checklist
024450	Cockpit Crew	Cockpit crew are discussing that the smoke has subsided.
024452	Cockpit	"Aural Warning for Smoke" was heard in cockpit.
024524	Cockpit	Auto callout of 400 was heard in the cockpit.
024530		Auto callout of 100 was heard in the cockpit & simultaneously Autopilot was disengaged.
024540		Auto callout of minimums.
024555		Auto callout of 50, 40…. retard was heard in the cockpit.
024503		Touchdown sound was heard
024802	Cockpit Crew	Cockpit crew were discussing that they will disembark the passengers first, then only cargo doors will be opened with all the fire fighting teams.
024837	Cockpit Crew	Cockpit crew discussing that there is smoke somewhere
024926	Cockpit Crew & ATC	Crew confirms with ATC if firefighting team are there for which ATC informs that they are following the aircraft.

024952	Cockpit Crew &ATC	Crew Confirms with ATC if secondary runway of 01L dumbbell is the isolation bay and informs that passengers will be disembarked first then they will open cargo door. They were also Confirming with ATC for ladder & other equipment.
025038	CC & Cockpit crew (PIC)	CC informs cockpit crew that the smoke has subsided a little bit so they will just open the door in the disarmed mode.
025053		Cockpit Crew asks CC that if that is the procedure? For which CC informs that since the smoke is not dense and only in case of dense smoke they need to evacuate.
		PIC confirms with CC if they want to open the door for which the CC confirms that they will just open the door. PIC asks CC to just disarm the doors first.
025134	Cockpit Crew	Co-pilot discussing with PIC that they can ask CC to open the door so that the smoke will subside.
025148	Cockpit Crew	Co-pilot asks PIC if he can switch off the engine?
025158	Cockpit/Cockpit Crew	"Aural Warning for Smoke" was heard in cockpit and simultaneously PIC calls Standby
025202	(PIC) to CC	PIC instructs CC to open the doors.
025208	Cabin	CCIC informs all CC to dis-arm slides.
025312		Sound of engine spooling down
025322	Cockpit crew	Cockpit crew discussing that the smoke must have subsided by now.
025336	CC to Cockpit crew	CC informs cockpit crew that they have opened all the doors in disarmed mode and the smoke has reduced.

1.11.2 Digital Flight Data Recorder

Following are salient observations of DFDR readout: -

Time (UTC)	Parameters	Event
164815	Radio height: 14988 ft, Calibrated Air Speed (CAS): 327 kts Engine # 2: N1 - 35.03% , N2 - 68.81%	Lavatory Smoke warning
165133	Radio height: 5824 ft, CAS: 271.5 Kts, Engine # 2: N1 – 34.38% , N2 – 74.38%	Avionics Smoke Warning
165821	Radio height: 2016 ft, CAS: 143.9 Kts,	Smoke in forward Cargo

	Engine # 2: N1 – 48.5 % , N2 – 80.56 %	
170124	Radio height: 0 ft, CAS: 131.3 Kts, Engine # 2: N1 – 48.06 % , N2 – 79.31 %	Touch Down
170331	Ground Speed: 23 kts, Engine # 2: N1 – 19.72 % , N2 – 62.19 %	Smoke in Aft Cargo
170548	Engine # 2: N1 – 19,78 % , N2 – 62.25 %	Aircraft came to its final halt.
170811	Engine # 2: N1 – 0 %, N2 – 17.75 %	Engine # 2 Switched Off
170900	Engine # 1: N1 – 0 %, N2 – 17.75 %	Engine # 1 Switched Off

1.12 Wreckage and Impact Information

Not applicable as the damages were confined to core Engine # 2 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. The crew had undergone post – flight medical test at Kolkata after the incident and the test result was found to be negative.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The Incident was survivable.

1.16 Test and Research

Nil

1.17 Organisational and Management Information

The aircraft is operated by an Indian registered Scheduled airline and are one of the launch customers for the Airbus A320 aircraft fitted with Neo engines. It operates scheduled flights to both domestic and international sectors.

1.18 Additional Information

As mentioned earlier, the engine manufacturer carried out the teardown inspection. In its Preliminary Observation Report of the occurrence, data of similar occurrences worldwide as on date of occurrence has been analysed and is given below: -

DRY FACE SEAL EVENTS STATISTICS

Detection	Event Date	Seal Time		
		Hours	Cycles	
ODM	04/30/18	204	37	
ODM	06/24/18	212	116	
ODM	07/06/18	71	25	
Odor	07/06/18	400	211	India
MCC	07/19/18	168	66	
ODM	08/06/18	195	130	India
ODM	08/12/18	59	41	India
Odor	08/20/18	837	163	
Odor	08/25/18	336	213	India
ODM	09/08/18	219	152	
OFDP	09/10/18	479	325	India
ODM	09/13/18	200	38	
ODM	09/16/18	256	106	
Odor	09/18/18	854	543	
ODM	09/19/18	153	82	India
ODM	09/28/18	142	128	
Odor	10/12/18	760	150	
OFDP	10/31/18	218	47	
ODM	11/14/18	225	49	
ODM	12/06/18	926	188	
Odor/Smoke	12/10/18	825	637	India

Worldwide Events

Total events : 21

ODM detected events: 12

Odor events: 5

OFDP detected events: 2

Odor/Smoke events: 1

India Events

Total events India: 7

ODM detected events in India: 3

Odor events in India: 2

OFDP detected events in India: 1

Odor/Smoke events in India: 1

Worldwide Events Breakdown

Events between 0 – 150 hrs: 3

Events between 150 – 250 hrs: 9

Events between 250 – 500 hrs: 4

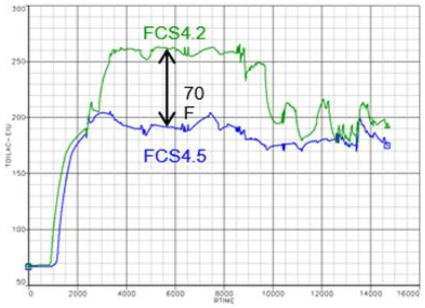
Events between 500 – 800 hrs: 1

Events above 800hrs: 4

Worldwide Event Engines with FCS 4.5: (0)

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 carbon seal wear correlates with high temperature exposure Rig data and flight tests. It was also confirmed that current design operates at higher than desired temperature. As per the Corrective Action Plan, interim measure to reduce event frequency was to implement software change to increase cooling.

Interim measure to reduce event frequency



Implement FCS4.5 software change to increase cooling.
SB 73-00-0032 issued Nov 1st 2018

The new thermally stable dry face seal design implements changes to the carrier & carbon sub assembly, as well as a reduction in spring load, to eliminate thermal elastic instabilities which will reduce operating temperature and improve seal life. Additionally, the new seal design incorporates shroud features to eliminate unwanted dynamic instability and carrier arresters to eliminate carbon fractures events, preventing smoke in the cabin events from No. 3 seal failure.

In order to eliminate the early wear out, it was also provided that thermal stability will be increased by reducing mass stiffness and having wider interface. Mechanical stability is improved through reduced seal carrier mass.

In addition, to eliminate the re-occurrence of smoke events and early capturing of the wear, Service Bulletin (SB) on "Engine - Air Seal Assemblies, No. 3 Bearing, Front and Rear - Inspection of the Air Seal Assemblies through the Main Gearbox Housing Breather Manifold Assembly (LB30) Compressor Intermediate Case Port" dated 30th Sept 2019 was also issued.

The SB contained detailed instructions for carrying out Boroscope Inspection (BSI) of the No. 3 bearing front and rear carbon seals for evidence of carbon seal wear for engines. As per the SB, the problem identified was that the No. 3 bearing front and rear carbon seal assemblies (can) experience premature wear that does not result in metallic chips detected via the Oil Debris Monitoring (ODM) system.

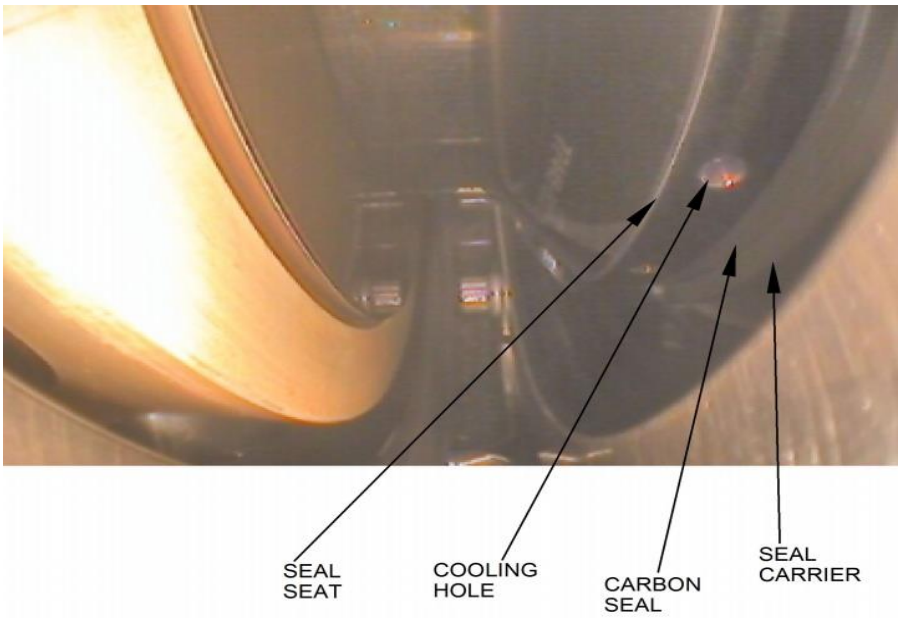
The reason of these premature wear events was that the seal seat could position itself inside ('nest') the carbon seal housing without contacting the face of the seal carrier assembly.

The SB required that for engines with less than 3000 hours of operation on the No. 3 bearing front and rear seals, BSI of the no. 3 bearing front and rear carbon seals be carried out at every oil filter change. It was also mentioned that the subject SB was the terminating action for the problem.

Indigo has been carrying out BSI as per the cycle mentioned by the OEM..

BSI of No. 3 Bearing

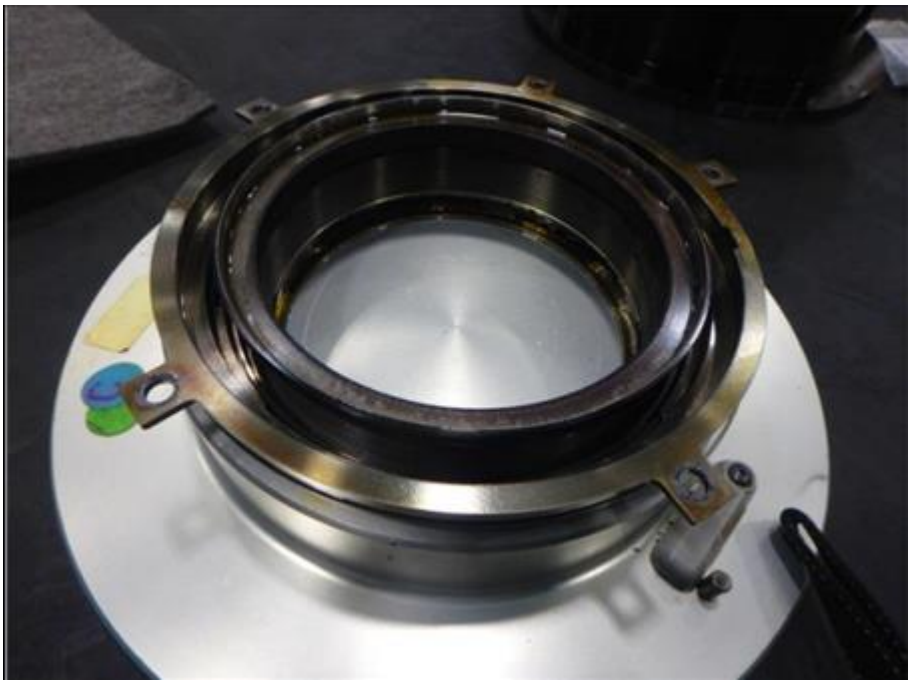
As seen during BSI, normal condition of the bearing No. 3 Front seal & seat and Rear Seal & seat are given below: -



Normal condition Front seal & seat

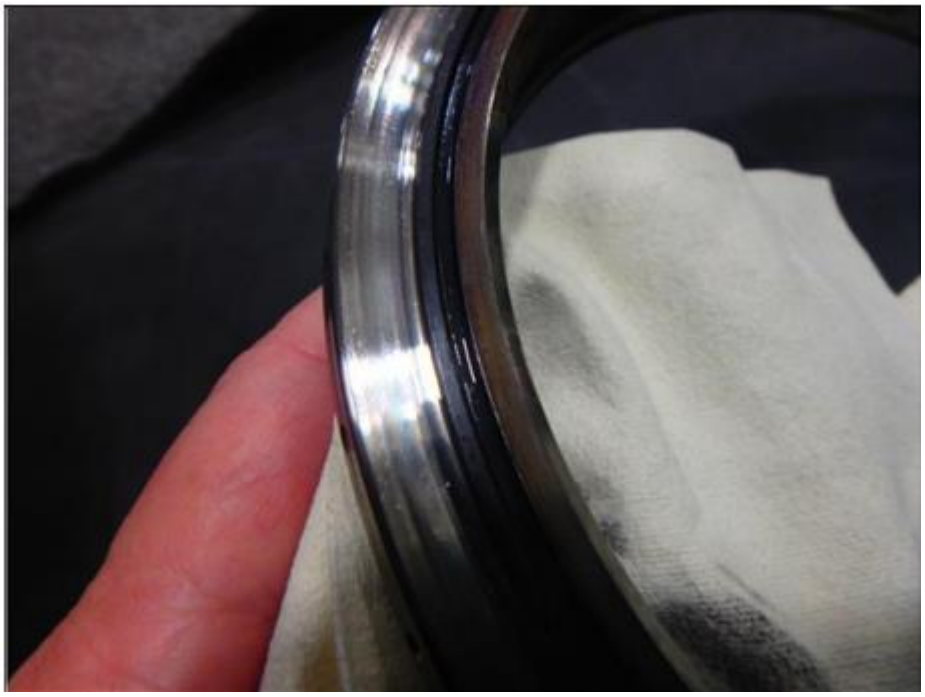
Normal Condition Rear Seal & Seat

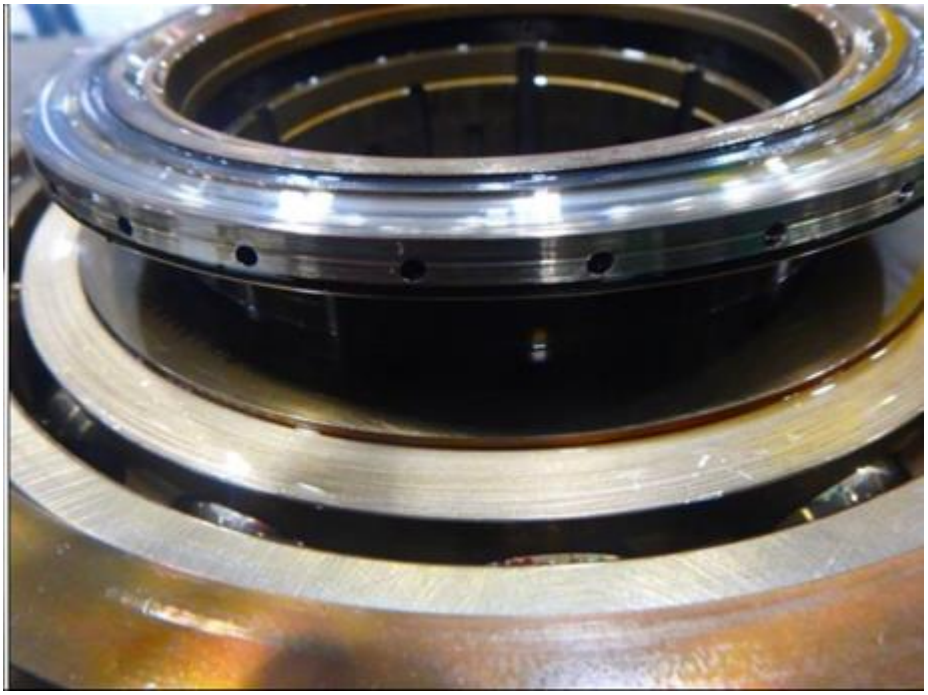
The actual condition of no. 3 bearing rear carbon seal of the involved engine (BSI carried out at CEC)



No. 3 bearing Rear Carbon Seal

The actual condition of no. 3 bearing rear carbon seat of the involved engine (BSI carried out at CEC)





No. 3 Bearing Rear Seal Seat

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 (Jaipur). 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.
- The visibility at the time of incident was within minima. Weather has no bearing on the incident.

2.2 Circumstances Leading to the Incident

During descent into Kolkata, the cabin crew reported smoke in the cabin, though they were not able to find the source of smoke. The smoke in the cabin got denser and while descending through FL 210, the cockpit crew also observed smoke in cockpit. Cockpit crew switched ON Ventilation/ Blower. As per the CVR, the crew immediately contacted

ATC Kolkata (Approach) and requested for a priority landing which was approved by the Approach Control. While descending through FL 170, the flight crew got ECAM warning for LAVATORY SMOKE.

Thereafter, FWD & AFT CARGO SMOKE warnings were observed in the cockpit, followed by AVIONICS SMOKE. The FDR and CVR readout indicate that the flight crew took the desired actions in coordination with the Cabin crew. When the aircraft was at 40 NM west of Kolkata, the smoke situation was worsening and the cockpit crew declared “MAY DAY” due to smoke.

Approach Control got the aircraft vectored by the shortest path and was given priority landing clearance for Rwy 01R by Tower Control.

Full emergency was declared at the airport and the aircraft landed safely, though during final approach and till touchdown, the “Aural Warning for Smoke” kept coming in the cockpit intermittently. The aircraft was grounded for thorough examination.

On ground, smell of smoke was observed in the cabin but there was no source of smoke observed in lavatory, avionics compartment or cargo compartments. Oil quantity of ENG # 2 was found to be 13 quarts which was 18 quarts at the beginning of flight. The consumption during the sector was abnormal. Engine ground run was carried out in presence of AAIB “Go-Team” during which smoke was observed in cabin with ENG # 2 running and packs on.

Metal particles were observed on ENG # 2 chip collector. The involved engine (ENG # 2) was removed from the aircraft for further detailed examination and aircraft released for further flight operations.

“Tear Down Inspection” of the engine was carried out by OEM and it was observed that #3 bearing rear carbon seal had worn out. It was also opined by the OEM that wearing out correlates with high temperature exposure than the desired (designed), observed during flight tests.

This wear of rear carbon seal resulted into the seal seat to position itself inside ('nest') the carbon seal housing without contacting the face of the seal carrier assembly causing excessive seal clearance and a loss of air pressurized sealing. The loss of sealing subsequently resulted in internal oil leakage into the higher temperature zone i.e. compressor secondary air systems and engine bleed air system. The oil then leaked into

the gas path and oil fumes/smoke released into the aircraft cabin & cockpit through the Bleed Valves.

2.3 Actions Taken by OEM & Operator to Avoid Recurrence

It was observed that the carbon seal wear was because of high temperature exposure during actual operation. In order to minimize the high temperature exposure, the OEM proposed to reduce the time of operation at event frequency (to increase cooling) by implementing software change(s).

The OEM came up with an immediate as well as long-term corrective action plan to arrest such failing.

The new thermally stable dry face seal design implements changes to the carrier & carbon sub assembly, as well as a reduction in spring load, to eliminate thermal elastic instabilities which will reduce operating temperature and improve seal life. Additionally, the new seal design incorporates shroud features to eliminate unwanted dynamic instability and carrier arresters to eliminate carbon fracture events, preventing smoke in the cabin events from No. 3 seal failure.

In order to eliminate the early wear out, it was also provided that thermal stability will be increased by reducing mass stiffness and having wider interface. Mechanical stability is improved through reduced seal carrier mass.

On 30th Sept 2019, in order to eliminate the re-occurrence of smoke events and early capturing of the wear, Service Bulletin (SB) on “Engine - Air Seal Assemblies, No. 3 Bearing, Front and Rear - Inspection of the Air Seal Assemblies through the Main Gearbox Housing Breather Manifold Assembly (LB30) Compressor Intermediate Case Port” was issued.

The SB required that for engines with less than 3000 hours of operation on the No. 3 bearing front and rear seals, BSI of the no. 3 bearing front and rear carbon seals be carried out at every oil filter change.

Indigo has been carrying out the task as per the above said SB. No similar occurrence has been reported since the compliance of this SB issued by Pratt & Whitney after the subject occurrence.

3.0 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.
2. Both pilots were appropriately qualified to operate the flight.

3. The weather was fine and did not contribute to the occurrence.
4. All concerned Airworthiness Directives, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engines were found complied with.
5. No snag was reported by the crew on the flights prior to the incidented flight on the day of incident.
6. During descent into Kolkata, the cabin crew reported to cockpit crew about smoke in the cabin but could not locate find the source of smoke.
7. While descending through FL 210, the cockpit crew also observed smoke in cockpit and subsequently switched ON Ventilation/ Blower. Crew requested ATC Kolkata (Approach) for priority landing.
8. First the ECAM warning for LAVATORY SMOKE came and thereafter, FWD & AFT CARGO SMOKE warnings came in the cockpit, followed by AVIONICS SMOKE.
9. When the aircraft was at 40 NM west of Kolkata, the cockpit crew declared “MAY DAY” due to smoke in cabin, lavatory and cockpit to ATC Kolkata.
10. Source of smoke could not be established in flight.
11. The aircraft was vectored by the shortest path by the Approach Control and was later given landing clearance for Rwy 01R by Tower Control.
12. Full emergency was declared at Kolkata airport and the aircraft landed safely.
13. During final approach and till touchdown, the “Aural Warning for Smoke” kept coming in the cockpit intermittently.
14. The aircraft was taken to the isolation bay (Runway 01L dumbbell) and all passengers were disembarked there.
15. During the “Tear Down Inspection” at OEM facility, it was observed that the No.3 bearing rear carbon seal had failed in service.
16. Failure of No.3 bearing rear carbon seal in flight caused oil leakage into the gas path and oil fumes/smoke released into the aircraft cabin through the Bleed Valves.
17. To eliminate the re-occurrence of smoke events and early capturing of the wear, Service Bulletin (SB) on “Engine - Air Seal Assemblies, No. 3 Bearing, Front and Rear - Inspection of the Air Seal Assemblies through the Main Gearbox Housing Breather Manifold Assembly (LB30) Compressor Intermediate Case Port” dated 30th Sept 2019 was issued.
18. It was mentioned that the subject SB was the terminating action for the problem and no similar occurrence has been reported since the compliance of this SB.

3.2 Probable Cause of the Incident

The incident occurred due to wearing out of No. 3 Bearing Rear Carbon Seal, causing oil leak into the gas path and release of oil fumes/ smoke into the aircraft cabin & cockpit through the Bleed Valves.

4.0 SAFETY RECOMMENDATIONS

NIL

(Corrective Actions initiated by the OEM and subsequent compliance by the operator has been adequate to obviate recurrence).

-S/d-
(Anil Tewari)
Investigator - In - Charge

-S/d-
(K Ramachandran)
Investigator

-S/d-
(R S Passi)
Investigator

Date: 22.01.2021

Place: New Delhi