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FINAL INVESTIGATION REPORT ON SMOKE IN PASSENGER CABIN INCIDENT OF M/S SPICEJET DASH8 Q-400 AIRCRAFT VT-SUR ON 02/07/2022 AT DELHI

DIRECTORATE GENERAL OF CIVIL AVIATION
GOVERNMENT OF INDIA
NEW DELHI-110003

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FOREWORD

This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. The investigation has been carried out in accordance with Annex 13 to the convention on International Civil Aviation and under Rule 13 (1) of Aircraft (Investigation Accidents and Incidents) Rules, 2017.

The investigation is conducted not to apportion blame or to asses individual or collective responsibility. The sole objective is to draw lessons from this incident which may help to prevent future accident or incident.

ABBREVIATIONS

Abbreviation	Expanded form
ADC	Air Defense Clearance
ATC	Air Traffic Control
ATPL	Airline Transport Pilot license
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DME	Distance Measuring equipment
FIC	Flight Information Center
FL	Flight Level
IFR	Instrument Flight Rules
VFR	Visual Flying Reference
ILS	Instrument Landing System
PAPI	Precession Approach Path Indicator
UTC	Universal Coordinated Time
DVOR	Doppler Very High Frequency Omni Range
ENG	Engine
P&W	Pratt & Whitney
FRTO	Flight Radio Telephony Operator
IR	Instrument Rating
LH	Left Hand
C of A	Certificate of Airworthiness
ARC	Airworthiness Review Certificate
RGB	Reduction Gear Box
BAS	Bleed Air System
ECS	Environmental Control System
ECU	Electronic Control Unit
ICAO	International Civil Aviation Organization
ARP	Aerodrome Reference Point
MLG	Main Landing Gear
NLG	Nose Landing Gear
CDS	Central Diagnostic System
EMU	Engine Monitoring Unit
ADD	Acceptable Deferred Defect
AMM	Aircraft Maintenance Manual
FIM	Fault Isolation Manual
SG	SpiceJet
DEL	Delhi
HP	High Pressure
LP	Low Pressure
SCT	Scattered
TM	Turbo Machinery
FH	Flight Hours

FINAL INVESTIGATION REPORT ON SMOKE IN PASSENGER CABIN INCIDENT OF M/S SPICEJET DASH8 Q400 AIRCRAFT VT-SUR AT DELHI ON 02/07/2022

1.	Aircraft	Type	DASH8 Q400
		Nationality	Indian
		Registration	VT-SUR
2.	Owner and Operator		M/s NAC Aviation 23 Limited and M/s Spicejet
3.	Pilot – in –Command		ATPL Holder
	Extent of injuries		Nil
4.	Date & Time of Incident		02.07.2022, 0123 UTC
5.	Place of Incident		Delhi
6.	Co-ordinates of Incident site		Latitude 28^0 34' 07" N Longitude 77^0 06' 44" E
7.	Last point of Departure		Indira Gandhi International Airport, New Delhi (VIDP)
8.	Intended place of landing		Jabalpur (VAJB)
9.	Number of Passengers on board		57
10.	Type of Operation		Schedule (Passenger) Flight
11.	Phase of Operation		Climb
12.	Type of Incident		Smoke in Passenger Cabin

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

SYNOPSIS:

M/s Spicejet, DASH8 Q400 aircraft VT-SUR while operating a scheduled passenger flight SG-2962 from Delhi to Jabalpur was involved in an air turn back incident at Delhi on 02.07.2022. The aircraft took off from Delhi and while climbing passing FL50 to FL60, cabin crew noticed smoke in cabin and heard a continuous alarm sound coming from the lavatory. Cabin crew informed cockpit crew about mild smoke in the cabin and on visual inspection, no sign of fire/smoke were observed. Smoke detector alarm and red light were ON which went off after a few seconds. Subsequently while climbing passing FL140, mild smoke and smell were increasing in the cabin and the same was informed to PIC by the cabin crew.

Aircraft leveled off at FL150, smoke smell was felt in the flight compartment and an air turn back was initiated. ATC was apprised about the same and MAY DAY was declared. Flight crew carried out associated Non Normal Checklist and aircraft landed back safely at Delhi. The passengers were evacuated from L1 and L2 exit on Taxiway G and were taken to terminal building in buses and coaches. Aircraft was towed and parked at Bay No. 177. There were no evidences of external fire available in the aircraft or in the vicinity. There were no injuries to any of the crew members or passengers on board the aircraft.

According to PIC, there were no associated fire/smoke warnings in the flight deck and all other engine parameters were found to be normal. Also there was no visible smoke in the cockpit.

During post flight inspection, oil leakage was observed from Engine Number 1. The involved ENG#1 was removed and sent to P&W for investigation and repair to establish the actual cause of the incident.

DGCA instituted the investigation by appointing investigator-in-Charge under Rule 13(1) of the Aircraft (Investigation of Accidents and Incidents) Rule 2017. The investigation revealed that the damaged carbon seal of bearing No.4 on ENG #1 allowed ingress of lubricating oil into gas path and it entered into air conditioning system **through engine bleed ports which led to smoke and odour** in the passenger cabin.

1. FACTUAL INFORMATION:

1.1 History of flight:

1.1.1 On 02/07/2022, M/s Spice jet, DASH8 Q400 aircraft VT-SUR was operating a schedule passenger flight SG-2962 from Delhi to Jabalpur. The flight was under the command of duly licensed PIC on type along with the duly qualified First Officer. There were 02 cabin crew and total 57 passengers on board the aircraft. This was the first sector for the aircraft and for the flight crew, PIC was the pilot flying & first officer was the pilot monitoring.

1.1.2 Before the flight, both the flight crew had undergone Breath Analyzer examination at Delhi and the test results were found negative. The flight was operating Delhi to Jabalpur after having proper ADC and FIC obtained. The flight plan revealed that the flight was

planned to be conducted under IFR. Before undertaking the flight, aircraft was declared airworthy after carrying out Pre-flight Inspection by appropriately approved person.

1.1.3 As per flight plan Varanasi and Lucknow was planned as two destination alternate aerodromes and fuel was uplifted accordingly. There was total 3100 kg of fuel on board the aircraft. The take-off weight of the aircraft was 26263 kg which was well within the max takeoff weight of 29574 kg. The CG of the aircraft was well within limits during the entire flight. The flight preparation was done normally and the aircraft was airworthy.

1.1.4 Following a normal pre-flight check and taxi to the runway, aircraft took off uneventfully from Delhi around 00:57:36 UTC. After takeoff during climb passing FL60 a continuous alarm was heard by the cabin crew from the lavatory, she informed the same to PIC, on PIC instructions cabin crew checked the lavatory and there was no sign of fire and smoke. However, smoke detector alarm and red light was ON, which went off after few seconds. While crossing FL130, PIC instructed cabin crew to check further if there is any other indication or smoke. So cabin crew checked overhead bins, under seat and galley and found no sign of fire. After a few seconds cabin crew informed PIC that she observed mild smoke and the smell was increasing in the cabin. Flight crew leveled off at FL150 and decision was made to return back to Delhi.

1.1.5 Flight crew informed ATC about the situation and carried out Non Normal Checklist for unknown source of smoke. Oxygen masks were donned by the flight crew and once cabin reported increase in smoke 'MAY DAY' was declared. Flight crew carried out immediate descent and while crossing FL100 as smoke was still there in the cabin, both the packs and bleeds were closed, forward and rear outflow valve were opened. During descent and approach, smoke was reported to be reducing, however the source of smoke could not be identified. According to PIC, there were no associated fire/smoke warnings or visible smoke in the flight deck and all other engine parameters were normal.

1.1.6 Flight crew informed ATC that after landing they would be evacuating and necessary assistance was requested. After safe landing at Delhi, the passengers were evacuated from L1 and L2 exit on Taxiway G and were taken to terminal building in buses and coaches. Aircraft was towed and parked at Bay No. 177. There were no injuries to any of the crew members or passengers on board the aircraft.

1.1.7 During post flight inspection, aircraft interior cabin, cockpit, galley area, lavatory and both cargo hold areas were checked for any visible smoke / fire indication & no sign of visible smoke/fire was observed. However, minor smell of smoke was felt. Further, both engines were checked for any external oil leak signs & observed oil dripping from left engine drain mast & oil leakage / streaks marks were found on ENG#1 lower cowl. ENG #1 oil level was found at minimum as the oil leakage was due to cracks on inter-compressor case strut of ENG # 1. The aircraft was grounded at Delhi for replacement of ENG#1. The involved ENG#1 was removed and sent to P&W for investigation and repair.

1.2 Injuries to persons:

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil
None	04	57	Nil

1.3 Damage to aircraft:

Damage to the aircraft was restricted to ENG # 1 only, inspection of LH engine inter compressor case top and bottom struts was carried out for evidence of oil leakage & found oil stains /wetness in said area along with cracks on inter-compressor case strut.

1.4 Other damages: There were no other damages.

1.5 Personnel Information:

1.5.1 Pilot-in-Command

Age	:	64 Years/Male
License	:	ATPL
Date of issue	:	30.12.2015
Valid up to	:	17.12.2025
Category	:	Airplane
Date of medical Exam	:	23.06.2022
Exam valid up to	:	30.11.2022
Date of issue of FRTO license	:	30.11.2015
FRTO license valid up to	:	29.12.2026
IR rating and instructor rating	:	N/A
Total flying experience	:	14977:37 Hrs
Total flying experience during last 1 year	:	490:26 Hrs
Total flying experience during last 6 months	:	228:28 Hrs
Total flying experience during last 30 days	:	58:30 Hrs
Total flying experience during last 07 days	:	10:30 Hrs
Total flying experience during last 24 hours	:	00.00 Hrs
Duty time last 24 hours	:	00:00 Hrs

1.5.2 Co- Pilot

Age	:	28 Years/Female
License	:	CPL
Date of issue	:	14.12.2019
Valid up to	:	13.12.2024
Category	:	Airplane
Date of medical Exam	:	08.10.2021

Medical Exam valid up to	:	15.10.2022
Date of issue of FRTO license	:	14.12.2019
FRTO license valid up to	:	13.12.2024
IR rating and instructor rating	:	03.04.2022
Total flying experience	:	253:20 Hrs
Total flying experience during last 1 year	:	53:15 Hrs
Total flying experience during last 6 months	:	53:15 Hrs
Total flying experience during last 30 days	:	30:36 Hrs
Total flying experience during last 07 days	:	10:02 Hrs
Total flying experience during last 24 hours	:	00:00 Hrs
Duty time last 24 hours	:	00:00 Hrs

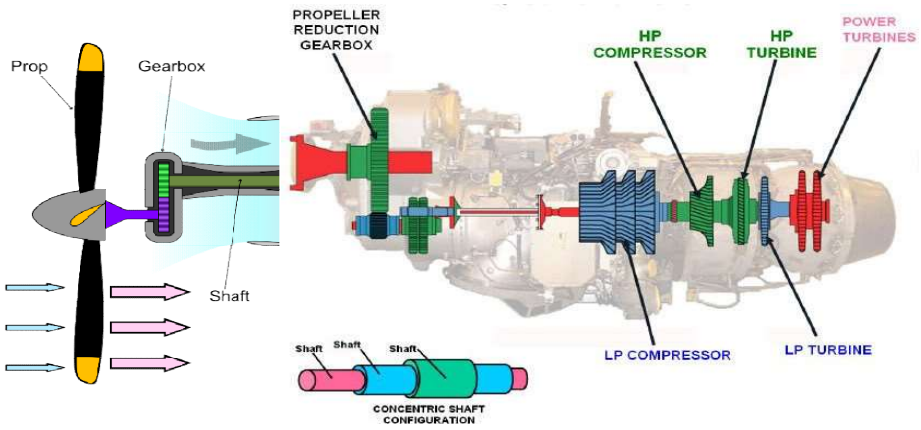
1.6 Aircraft Information:

1.6.1 Technical Information:

Manufacturer	De-Havilland	
Type	DHC8-400	
Sr. No.	4342	
Year of manufacturer	2010 - (30.12.2010)	
Certificate of airworthiness, date of issue and validity	19.10.2016 and being fulfilled along with valid Airworthiness Review Certificate	
Category	CAT A	
Certificate of registration	4713/4 dated 17.12.2020	
Owner	M/s NAC Aviation 23 Limited, Ireland	
Maximum all up weight authorised	29574.00 kg	
Last major inspection	6 year check	
Last inspection	Check 2	
Airframe Hrs since new	22727:06 Hrs	
Airframe Hrs since last C of A/ARC	13947:00 Hrs	
ENGINE INFORMATION	No.1	No.2
Manufacturer	Pratt & Whitney	Pratt & Whitney
Type	Turboprop (PW 150A)	Turboprop (PW 150A)
Serial No.	PCE-FA0459	PCE-FA0890
Hrs done since new	25898:10 Hrs	19089:53 Hrs
Hrs done since overhaul	4121:10 Hrs	717:33 Hrs
Last major inspection carried out	6 Year check	6 Year check
Last inspection	Cleaning of P2.2 Bleed valve filter	Engine performance recovery wash
Average oil consumption	0.504 Qtz/hr	0.031 Qtz/hr
Type of fuel used	Jet A1	Jet A1

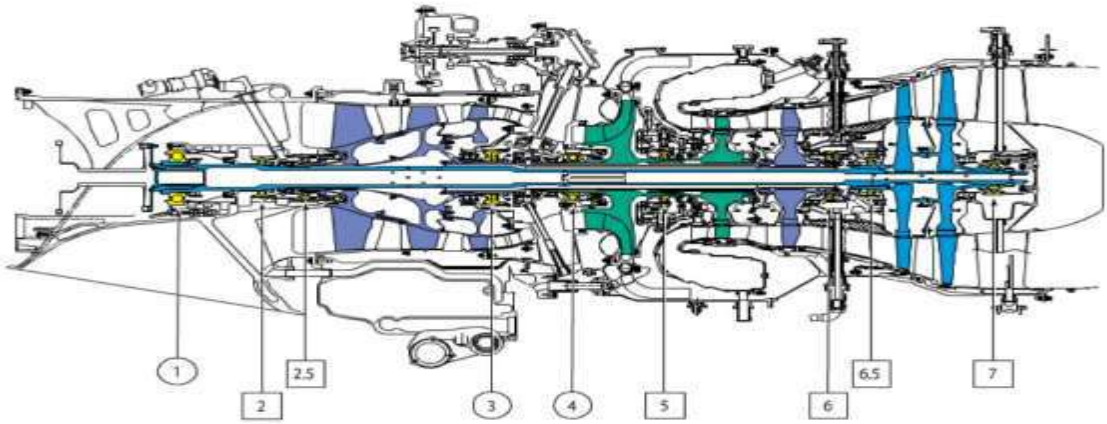
1.6.2 DASH8 Q400:

1.6.2.1 DASH8 Q400 is a twin turboprop powered aircraft fitted with two PW150A engines. The engine is a three spool, free turbine-propeller engine. Engines assist in generating hydraulic power and electric power to meet aircraft operational requirements. They also supply pressurized bleed air to the aircraft for functioning conditioning and pressurizing the aircraft cabins for allowing aircraft to fly at high altitude.



1.6.2.2 The engine has two modules, reduction gearbox module and turbo machinery module. The RGB reduces the power turbine shaft speed and increases the torque. The output from the RGB is used to drive the propeller. The turbo machinery module contains the axial and centrifugal compressors, combustor, high pressure, low pressure and power turbines and accessory drives. The axial and centrifugal compressors and the power turbines are attached to co−axially located shafts which are supported by roller and ball bearings. Also found on the turbo machinery module are the fuel, oil and air system components.

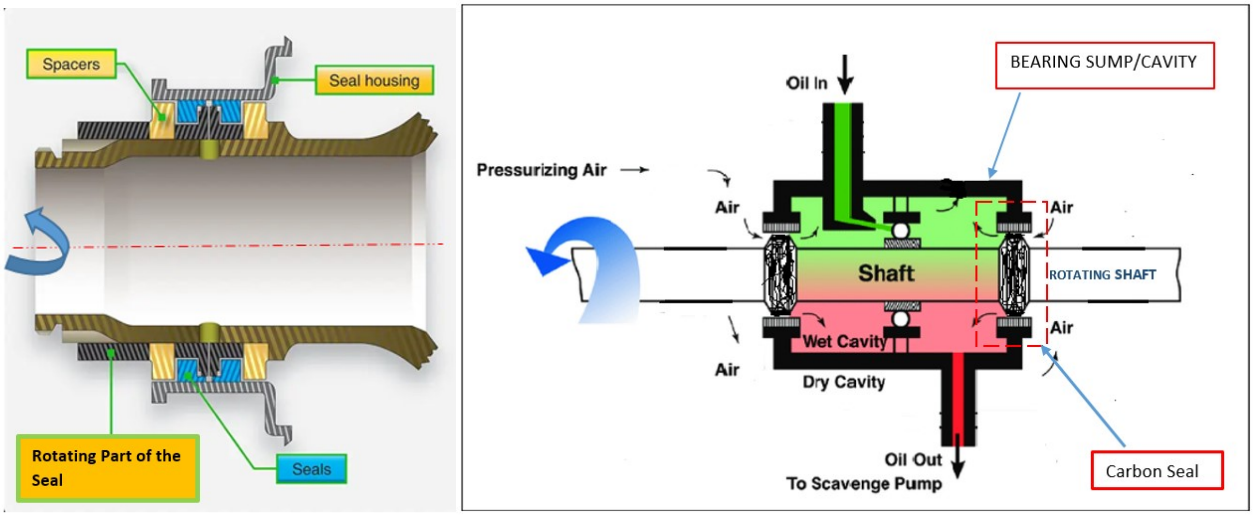
1.6.2.3 Nine bearings are used to support three rotating shafts of the engine. These bearing are ball bearing to withstand the thrust and radial bearings to take radial loading and permit axial movement caused by thermal expansion. The forward end of the High pressure (HP) shaft is supported by a ball bearing (No 4), in front of the impeller. The aft end of the shaft is supported by a roller bearing (No 5).Low pressure shaft (LP) supported by roller bearing (No.2.5) & ball bearing (No.3) at front and roller bearing (no.6) at rear. Free Power turbine shaft supported by ball bearing (No.1) & roller bearing (No.2) at front and roller bearings (No.6.5 & 7) at rear.



1.6.2.4 These bearings require an oil lubrication system that provides a thin film of oil between the moving parts of the bearing. Without oil, the metal-to-metal contact would cause the engine to grind and generate tremendous amounts of heat which would eventually lead to metallic failure. Bearings are confined in an enclosed chamber to shield from a gas path called Sump or cavity.

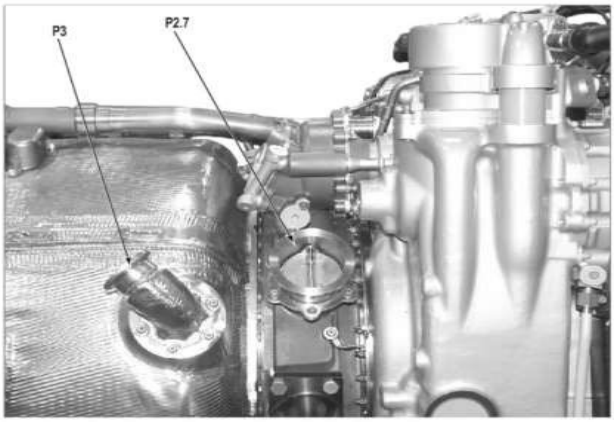
1.6.2.5 The bearing sumps / cavities enclose a bearing for supporting rotation of the rotating LP, HP & Free turbine shaft which allow these shafts to rotate at high RPM to perform intended function yet secured with a stationary section inside the gas generating path inside the core engines. The bearing housing usually contains oil seals for the purpose to prevent the oil leaking from its bearing sump to the gas path of flow (primary airflow). **A leaking seal in a turbine engine could cause bearing failure, or cockpit & cabin fumes.**

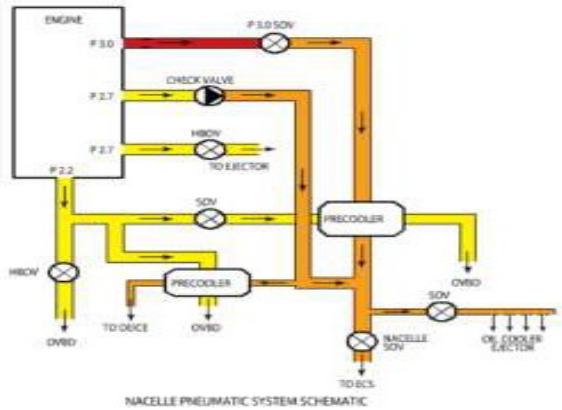
1.6.2.6 PW150A engine bearing sumps are designed with carbon seals on both ends of the sump and the No. 3 and 4 bearing cavity is sealed on each end using a double carbon seal ring. The typical carbon seals used for bearing No. 3 &4 sump is made of two sections, a stationary section which is in build with carbon rubbing surface on its inner face and smooth metallic mating rotating surface. Rotating part gets snugly fitted over the rotor shaft and stationary carbon inner surface section immediately seats against the rotating mating surface when attach with bearing housing. Close rubbing surfaces between these sections provide a sealing surface to contain oil lubricant inside the sump. Regardless of sealing provided by carbon seals, lubricating oil under the influence of high temperature and pressure always tends to cross pass sealing surfaces and penetrate into normal airflow air. If lubricating oil is allowed to enter onto the gas path, oil loaded air might enter the aircraft air-conditioning system through bleed port P 2.2 and P2.7.



1.6.2.7 To seize the possibility of oil leakage through carbon seals seated in bearing sumps, high air pressure from the compressor is utilized to pressurize the air side surface of the carbon seal. In particular pressurized with P2.8 (HP compressor split vane impeller level) directed through internal passages in the inter-compressor case carbon seal at either end of bearing sump/cavity of PW150A Engine. **If carbon seals fail** or pressurization of bearing sumps does not work well for any reason, high pressure Engine lubrication oil from the bearing sump shall enter into the dry airside of the sump and contaminate the airflow.

1.6.2.8 Bleed air for the pneumatic systems is supplied by the engines for air conditioning and pressurization. The Bleed Air System (BAS) is part of the Environmental Control System (ECS) which supplies conditioned air to the flight and cabin compartments. Compressed Bleed air is ducted from the Low Pressure (LP) compressor port or the High Pressure (HP) compressor port of each engine. Power lever position and the Electronic Control Unit (ECU) determine whether the HP port or the LP port will be used, when bleeds are selected ON.





NACELLE PNEUMATIC SYSTEM SCHEMATIC

1.6.2.9 The engine provides air bleed extraction ports from both compressors, the low pressure (LP/P2.7) and the high pressure (HP/P3). As the two bleed ports are connected to the same duct, a P2.7 check valve is installed in the low pressure port to prevent back flow from the high pressure (P3) to the low pressure (P2.7). The Environment Control System (ECS) is supplied with low pressure air (P2.7). At low engine power, P3 port is allowed to supply air to feed the airframe system and at a predetermined pressure (P3) port gets closed and supply of required bleed taken over by the P2.7 port for Environment Control System (ECS)

1.6.2.10 Compressed bleed air ported from engine goes to Air conditioning pack for temperature and humidity control for passenger cabin and Cockpit. **If oil leaking from bearing sumps enters into the gas path, it will be carried into cabin /cockpit through engine bleed ports, airframe ducts and ECS to cabin and lead to smoke and odour** depending upon quantity of contamination.

1.6.3 Maintenance History:

1.6.3.1 On 29.06.2022, during halt at Jaipur, CDS retrieval carried out, found fault code 938 in both channel of engine #1 (turbo machinery chip detector maintenance request). Respective FIM task was referred & turbo machinery chip detector was removed as per AMM. Further, the same was inspected for debris, found small quantity fuzz on the chip detector & the same was permissible as per AMM and there was no prior history of debris within the last 400 hrs. Then, turbo machinery chip detector Installed back as per procedure.

1.6.3.2 Subsequently, main oil filter was removed and the same was checked for debris & no debris was observed. However, the diagnostic filter layer was removed and was sent for further investigation & the main oil filter installed back as per procedure. Post installation, leak check was carried out, same was found satisfactory & no leak was observed. Further retrieval of data from the central diagnostic system (CDS) – Engine Monitoring Unit (EMU) was carried out as & found no further fault code.

1.6.3.3 TM (Turbo Machinery) chip detector particles & MOF (Main Oil Filter) diagnostic layer sent to power plant for analysis. ADD (Acceptable Deferred Defect) was raised to check the turbo machinery chip detector for debris daily for 50 FH and main oil filter to be checked for debris after 50 FH. Then, duplicate inspection for #1 ENGINE Main Oil Filter installation carried out & found satisfactory. No leak observed. As such, the aircraft was normalized & released for further flights.

1.6.3.4 Thereafter, on 30.06.2022, during halt at Delhi, LH ENG oil samples were collected & were handed over to Delhi stores & the aircraft was normalized. Further on 01.07 2022, during halt at Delhi, preventive maintenance actions were carried out & owing to CAMP alert Engine #1 Fault code 939 (RGB Chip Detector), respective FIM task was referred. Removal and inspection of chip detector magnetic plug was carried out & very small chip particles were observed, which were within AMM limits. However, as precautionary measure, replacement of scavenge oil filter was carried out as per AMM.

1.6.3.5 Subsequently, Engine oil was replaced as per AMM & post replacement, Engine oil leak check was carried out & the same was found satisfactory with no leakage. Thereafter, duplicate inspection for security of installation was carried out & the same was also found satisfactory. After that, Engine run for system check was carried out & found satisfactory.

1.6.3.6 Then, retrieval of the data from CDS-EMU was carried out as per AMM & the same was found satisfactory with no fault codes. As such, the aircraft was normalized & was released for further flights. Further, on 02.07.2022, Spicejet DASH8 Q400 aircraft VT-SUR was operating SG-2962 from Delhi to Jabalpur. **Scrutiny of the tech log pages 30 days prior to the date of occurrence revealed that no similar snag was reported on this aircraft.**

1.7 Meteorological Information: The prevailing weather at Delhi was within approved minima of crew and aircraft. The reported visibility was 3000 meter & winds 100^0/05 knots cloud SCT 3500 feet, QNH 999, temperature 28^0 C, Dew Point 26^0 C. Runway surface condition was dry and there were no rain or turbulence.

1.8 Aids to Navigation: Delhi Airport is equipped with DVOR, Cat IIIB ILS, PAPI and High Power DME. It has also a secondary surveillance RADAR for providing route navigation services. ASMGCS is also functional on the airport for surveillance aircraft and vehicular movement in operational area. All the equipments were serviceable. Navigational Aids fitted in the aircraft were also serviceable.

1.9 Communication: There was always two ways communication between the ATC and the aircraft. Communication equipment in the aircraft and ATC were serviceable.

1.10 Aerodrome Information:

Indira Gandhi International (IGI) Airport, New Delhi is a civil aerodrome. The operations are controlled by GMR and ATC is controlled by Airports Authority of India. Airport has got ICAO Code VIDP, ARP coordinates are 28°34'07"N, 77°06'44"E and is located 15 KM from Delhi railway station. The elevation is 777 feet and type of traffic permitted is IFR/VFR. Aerodrome

category for firefighting is CAT-10 and Rescue equipment's are available as per category. Delhi airport has three runways with orientation 27/09, 28/10 and 29/11.

1.11 Flight Recorders: The Cockpit Voice Recorder (CVR) data and the Digital Flight Data Recorder (DFDR) data were downloaded and the following information was available from them:

1.11.1 DFDR:

Time (in UTC)	Sequence of events
00:43:36	Engine #2 Start
00:43:47	Bleed position R: Normal
00:44:27	Engine #1 start
00:44:35	Bleed position L: Normal
00:45:19	Flap 10 selected
00:46:52	Aircraft started Taxi
00:56:34	Bleeds Off
00:57:36	Aircraft Airborne Selected Altitude: 6000
00:57:46	MLG and NLG Up and Locked, Altitude: 176 ft(radio), CAS: 148 knots
00:58:14	Bleed position L and R: Normal
00:58:24	Flaps Up, Altitude: 1586 ft(radio), CAS: 177 knots
01:06:36	Aircraft Levelled off at FL 150
01:08:18	Selected Altitude: 6992 Altitude: 15008 ft(baro)
01:08:27	Aircraft commenced descent, Bleed position L and R: Normal
01:10:13	Bleed position L: Off
01:11:49	Bleed position L: Normal
01:12:53	Bleed position L: Min Bleed position R: Off
01:12:57	Bleed position L: Off Bleed position R: Off
01:19:23	Aircraft Levelled off at 2600 ft(baro)
01:23:24	MLG and NLG Down and Locked, Altitude: 1957 ft(radio) CAS: 159 knots
01:23:27	Aircraft commenced final descent
01:23:38	Flaps 15 selected, Altitude: 1816 ft(radio), CAS: 153.5 knots
01:26:03	Aircraft Landed, Bleed position L and R: Off
01:27:42	Both Engines Cut off

1.11.2 CVR:

Time of observation	Conversation
0:45:24:	Departure weather – At time 0000 hrs UTC, ILS approach for RWY 10 and RWY11, RWY 10 and RWY 11 in mixed mode, TL FL55, wind – 100/05, vis – 3000m, weather – mist, cloud – SCT 3500ft, temp – 28, DP – 26, QNH – 999

0:47:15		Delivery clearance: SG2962, cleared to JLR, flight plan route RWY 10 for departure, ITBAN 5E, climb 60, squawk – 0534
0:54:59		Departure briefing was carried out by the flight crew
1:04:29		The aircraft was cleared for pushback facing north abeam stand 160 L and start up was approved
1:05:21		Before start checklist was carried out by the flight crew
1:08:37		After start checklist was carried out by the flight crew
1:11:11		Taxi checklist was carried out by the flight crew
1:19:38		Line up checklist was carried out by the flight crew
1:19:59		The aircraft was cleared for takeoff RWY 10, wind 070 °/03 Knots
1:21:40		Continuous alarm annunciating
1:22:26		After takeoff checklist was carried out
1:23:02	SCC	Sir continuously alarm coming from washroom
	P1	Just open the washroom and check
	SCC	Ok Ok
1:23:54	P1	Alarm is coming?
1:24:32	SCC	Yes captain
	P1	What is the sound coming?
	SCC	SCC informed sound is coming from lavatory
	P1	Red light is ON in lavatory?
	SCC	Yes Yes
	P1	Smoke?
	SCC	SSC reported mild smoke in cabin
1:24:59	P1	The alarm went off?
	SCC	Yes Captain
1:27:46	P1	Sometime this smell comes from the pressurization system
	P2	Alright
	SCC	SSC reported smoke is increasing in the cabin
	P1	Ok…then we will go back and land
1:28:39	P1	Ok oxygen
	P2	Yes sir
1:29:00	The cockpit crew requested the ATC to stop climb at FL150 and return to DEL owing to some technical and the same was acknowledge by ATC.	
1:29:24	SCC	SCC reported increase in smoke in the cabin
1:30:39	P1	SG2962 we are reporting MAY DAY MAY DAY MAY DAY smoke in the cabin….immediate vectors
	ATC	SG2962, radar roger, turn right heading 300, vectoring for ILS approach…report preference for RWY…RWY 10
	P1	RWY 10 turning right 300
1:30:58	P1	Emergency checklist smoke
1:32:07-1:41:14	Flight crew carried out immediate descent and while crossing FL100 as smoke was still there in the cabin, both the packs and bleeds were closed, forward and rear outflow valve were opened. During descent	

	and approach, smoke was reported to be reducing; however the source of smoke could not be identified.	
1:43:32	P1	We will carry out evacuation after landing
	P2	Alright sir
1:46:32	The aircraft was cleared to land on RWY10, wind – 070 °/04 Knots	
1:50:00	ATC	SG2962, left on G contact ground 121.75
1:50:29	P2	Ground SG2962 on G, we are evacuating
	ATC	SG2962, taxi via G, F6, stand 177
	P1	We are switching off and evacuating
	ATC	SG2962 roger
1:51:20	P1	Cabin crew on stations, Evacuate Evacuate Evacuate on the left

1.12 Wreckage & Impact Information: Nil

1.13 Medical & Pathological Information: Before the flight, both the flight crew had undergone Breath Analyzer examination at Delhi and the test results were found negative.

1.14 Fire: There was no fire

1.15 Survival Aspects: The incident was survivable.

1.16 Tests & Research:

As per the Engine Shop report of Engine No. 1 (PCE-FA0459), during the engine review at teardown, the following were observed:

- Severely damaged N0.4 carbon seal and flexible housing
- Traces of oil in the cold section gas path components
- Cracks on inter-compressor case
- Rubbing and erosion on cold section Components.

It is evident from above observations that the damaged carbon seal of bearing No.4 on ENG#1 would have allowed ingress of lubricating oil into gas path and it entered into air conditioning system through P2.7 port and airframe ducts and resulted in smoke and odour in the passenger cabin.

1.17 Organizational & Management Information:

Spicejet is an Indian scheduled airline headquartered in Gurugram, Haryana, India. It has a fleet of aircrafts including B737-700, B737-800, B737-900ER, B737-MAX-8 and DASH Q400.

1.18 Additional Information: Nil

1.19 Useful or Effective Investigation Techniques: Nil

2. ANALYSIS:

2.1 Airworthiness & Serviceability of the aircraft:

2.1.1 On 29.06.2022 at Jaipur, turbo machinery chip detector & main oil filter was removed due to fault code 938, found small quantity fuzz on the chip detector which was permissible as per AMM, no debris was observed on oil filter. ADD was raised to check the turbo machinery chip detector for debris daily for 50 FH and main oil filter to be checked for debris after 50 FH. As such, the aircraft was normalized & released for further flights.

2.1.2 On 01.07.2022 at Delhi, as a part of preventive maintenance, chip detector magnetic plug was inspected & very small chip particles were observed, which were within AMM limits. However, as a precautionary measure, scavenge oil filter was replaced. Retrieval of the data from CDS-EMU was carried out same was found satisfactory with no fault codes. As such, the aircraft was normalized & was released for further flights.

2.1.3 DASH8 Q400 is a twin turboprop powered aircraft fitted with two PW150A engines. The aircraft and its engines were being maintained as per the approved maintenance program. No snag was pending for rectification before the incident flight nor was any repetitive/similar defect entered in the log book of the aircraft.

2.1.4 Certificate of registration, certificate of airworthiness, aero mobile license & Certificate of release to service in respect of the aircraft were valid. The noise certificate of the aircraft was current. Airworthiness Directives, Service bulletins, mandatory modifications on this aircraft and its engines have been complied with.

2.1.5 DASH8 Q400 aircraft engine is a three spool free turbine-propeller engine and has two modules, reduction gearbox module and turbo machinery module. Nine bearings are used to support three rotating shafts of the engine. PW150A engine bearing sumps are designed with carbon seals on both ends of the sump and No. 3 and 4 bearing cavity is sealed on each end using a double carbon seal ring. **If carbon seals fail** or pressurization of bearing sumps does not work well for any reason, high pressure Engine lubrication oil from the bearing sump shall enter into the dry airside of the sump and contaminate the airflow.

2.1.6 Compressed bleed air ported from engine goes to Air conditioning pack for temperature and humidity control for passenger cabin and Cockpit. **If oil leaking from bearing sumps enters into the gas path, it will be carried into cabin /cockpit through engine bleed**

ports, airframe ducts and ECS to cabin and lead to smoke and odour depending upon quantity of contamination.

2.1.7 As per the Engine Shop report of PCE-FA0459, during the engine review at teardown, it was observed that flexible housing & No.4 carbon seal on ENG # 1 was severely damaged with traces of oil in the cold section gas path components. Hence, it is concluded that, the damaged carbon seal of bearing No.4 on Engine #1 allowed the ingress of lubricating oil into gas path and it entered into the air conditioning system through engine bleed ports which led to smoke and odour in passenger cabin.

2.2 Pilot handling of the situation:

2.2.1 After takeoff from Delhi while climb passing FL60, PIC was informed by the cabin crew regarding continuous alarm coming from the lavatory, PIC instructed the cabin crew to check for any sign of fire and smoke. Initially there were no signs of fire and smoke, however smoke detector alarm and red light was ON, which went off after a few seconds. While crossing FL130, cabin crew informed PIC that she observed mild smoke and the smell was increasing in the cabin. Flight crew leveled off at FL150 and decision was made to return back to Delhi.

2.2.2 Flight crew informed ATC about the situation and carried out emergency checklist for unknown source of smoke. Oxygen masks were donned by the flight crew and once cabin reported increase in smoke 'MAY DAY' was declared. Flight crew carried out immediate descent and while crossing FL100 as smoke was still there in the cabin, both the packs and bleeds were closed, forward and rear outflow valve were opened. During descent and approach, smoke was reported to be reducing; however the source of smoke could not be identified. There were no associated fire/smoke warnings in the flight deck and all other engine parameters were found to be normal. Also there was no visible smoke in the cockpit.

2.2.2 Flight crew carried out emergency checklist for unknown source of smoke & smoke or fumes removal checklist in accordance with standard procedure and landed the aircraft safely. The flight crew actions were appropriate in terms of handling the emergency situation and post landing the passengers was evacuated unhurt.

2.3 Weather:

On 02.07.2022, M/s Spicejet DASH8 Q400 aircraft VT-SUR took off from Delhi at 00:57:36 UTC for a schedule passenger flight SG-2962 from Delhi to Jabalpur. The prevailing weather at Delhi was within approved minima of crew and aircraft. Runway in use 10-28, reported visibility was 3000 meters, winds 100^0/05 knots, cloud SCT 3500 feet, QNH 999, temperature 28^0 C, Dew Point 26^0 C. Runway surface condition was dry and there were no rain or turbulence. Metrological report did not show any significant change in trend of the prevailing weather. Weather was conducive for operations under Instrument Flight Rules (IFR). Hence weather was not a contributory factor to the incident.

3. CONCLUSION:

3.1 Findings:

3.1.1 The flight crew members were appropriately licensed and qualified to operate the flight.

3.1.2 The aircraft was operated within the provision of valid Certificate of Airworthiness and Certificate of Registration before the incident flight.

3.1.3 All the concerned Airworthiness Directive, Service Bulletins, Mandatory Modifications on this aircraft and its engines were found complied with.

3.1.4 On 29.06.2022 at Jaipur, turbo machinery chip detector & main oil filter was removed due to fault code 938, found small quantity fuzz on the chip detector which was permissible as per AMM, no debris was observed on oil filter.

3.1.5 ADD was raised to check the turbo machinery chip detector for debris daily for 50 FH and main oil filter to be checked for debris after 50 FH. As such, the aircraft was normalized & released for further flights.

3.1.6 On 01.07.2022 at Delhi, as a part of preventive maintenance, chip detector magnetic plug was inspected & very small chip particles were observed, which were within AMM limits. However, as precautionary measure, scavenge oil filter was replaced.

3.1.7 Retrieval of the data from CDS-EMU was carried out same was found satisfactory with no fault codes. As such, the aircraft was normalized & was released for further flights.

3.1.8 Scrutiny of the tech log pages 30 days prior to the date of occurrence revealed that no similar snag was reported on this aircraft.

3.1.9 The aircraft was maintained in airworthy condition and no defect was pending for rectification. Serviceability of the aircraft was not the contributory factor to the incident.

3.1.10 After takeoff from Delhi, PIC was informed by the cabin crew regarding continuous alarm coming from the lavatory with no sign of fire and smoke.

3.1.11 As the smoke was reported from unknown source by the cabin crew, MAY DAY was declared & emergency checklist was followed by the flight crew.

3.1.12 The flight crew actions were appropriate in terms of handling the emergency situation and post landing the passengers was evacuated unhurt.

3.1.13 As per the Engine Shop report of PCE-FA0459, during the engine review at teardown, it was observed that flexible housing & No.4 carbon seal on ENG # 1 was severely damaged with traces of oil.

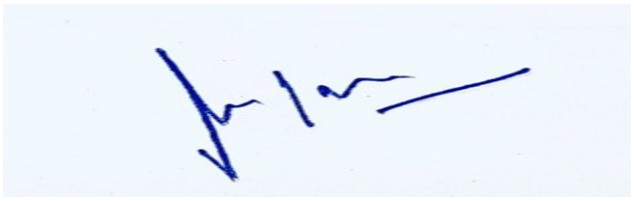
3.1.14 Damaged carbon seal of bearing No.4 on Engine #1 allowed the ingress of lubricating oil into gas path and it entered into the air conditioning system through engine bleed ports which led to smoke and odour in passenger cabin.

3.1.15 Weather was conducive for aircraft operation.

3.2 PROBABLE CAUSE OF THE INCIDENT:

Damaged carbon seal of bearing No.4 on Engine #1 allowed ingress of lubricating oil into gas path and it entered into the air conditioning system through engine bleed ports which led to smoke and odour in passenger cabin.

4. SAFETY RECOMMENDATIONS: NIL



(Vishal Yadav)
Dy. Director Air Safety (NR)
Investigating-in-Charge-VT-SUR

Date: 24-07-2023
Place: New Delhi