



**FINAL INVESTIGATION REPORT OF SERIOUS INCIDENT
INVOLVING M/s INDIGO AIRLINES' A320 AIRCRAFT VT-ITB
AT HYDERABAD ON 27/08/2019**

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Foreword

In accordance with Annex 13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an accident shall be the prevention of accidents and incidents and not apportion blame or liability. The investigation conducted in accordance with the provisions of above said rules shall be separate from any judicial or administrative proceedings to apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation and opinion obtained from the experts. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.

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- | | | |
|-----|---------------------------|--|
| 1. | Aircraft Type | : A320-271N |
| | Nationality | : INDIAN |
| | Registration | : VT - ITB |
| 2. | Owner | : M/s Avolon Aerospace (Ireland) AOE 50 Ltd. |
| 3. | Operator | : M/s Indigo Airlines |
| 4. | Pilot – in –Command | : ATPL holder on type |
| | Extent of injuries | : NIL |
| 5. | First Officer | : CPL Holder qualified on type |
| | Extent of injuries | : NIL |
| 6. | Place of Incident | : Hyderabad Airport |
| 7. | Date & Time of Incident | : 27 th Aug 2019, 1143 UTC |
| 8. | Last point of Departure | : Delhi |
| 9. | Point of intended landing | : Hyderabad |
| 10. | Type of operation | : Scheduled Operation |
| 11. | Crew on Board | : 02 Cockpit Crew, 04 Cabin Crew |
| | Extent of injuries | : NIL |
| 12. | Passengers on Board | : 159 |
| | Extent of injuries | : NIL |
| 13. | Phase of operation | : Approach |

(ALL TIMINGS IN THE REPORT ARE IN UTC)

1. FACTUAL INFORMATION.

1.1 History of the flight.

On 27.08.2019, Indigo's A320 aircraft VT-ITB was scheduled to operate flight 6E-6679 from Delhi to Hyderabad. The aircraft took-off from Delhi with 159 passengers on board. The flight was operated by a crew comprising 02 Pilots and 04 cabin crew.

The take-off, climb and cruise phases of flight were uneventful. As per the statement of Crew, a humming sound was observed in in the cockpit when the aircraft was 30 Miles before top of descent. Crew suspected that sound was originating from RH Engine. Later, a thud sound was heard by the crew, but all parameters were observed to be normal. Thereafter, perceptible smoke was observed by the crew in cockpit.

Pilot called the Cabin crew and enquired if any smoke or smell was present in the cabin. The cabin crew confirmed presence of burning smell in the cabin as well to the pilot. Thereafter, crew donned oxygen mask and declared "MAYDAY" to ATC Chennai at 1121 UTC. Crew also requested immediate descent and direct routing to Hyderabad. The request was acknowledged by ATC and immediate descent to FL330 was given. Permission for direct routing to Hyderabad was also given.

While descending, the crew carried out actions related to Vent Blower Fan alert on Electronic Centralised Aircraft Monitor (ECAM) and Smoke Procedure as per Quick Reference Handbook (QRH). On switching off the air-conditioning Pack 1, the burning smell subsided in the cockpit. Cabin Crew also confirmed decrease in smell in the cabin. At 1124 UTC, crew contacted Hyderabad Area Control on 120.95 Mhz. Aircraft was given descent to FL250, FL200 and FL150 in steps.

Hyderabad Area Control co-ordinated with Air Force areas comprising Bidar, Dundigal and Hakimpet before giving descent to FL100 at 1127 UTC and crew was asked to contact Dundigal ATC on 122.7 Mhz for further descent. Thereafter, crew co-ordinated with Dundigal ATC and came back to Hyderabad Area Control at 1135 UTC. Crew was advised to contact Hyderabad Approach on 120.25 Mhz.

Aircraft was vectored by Hyderabad Approach for an ILS approach to RWY 27L. The aircraft was established on Localiser at 1143 UTC and was advised to contact Tower on 118.45 Mhz at 6.5 Miles from touchdown. The aircraft was given clearance to land by Tower at 1143:46 UTC and touch down was executed at 1146 UTC, making a safe landing. The aircraft then taxied to Stand 19 and was parked at 1152 UTC. Firefighting

vehicle had been positioned by Hyderabad ATC and followed the aircraft to the stand. No fire was observed and normal deplaning was carried out. All passengers disembarked safely.

1.2 Injuries to Persons.

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil

1.3 Damage to Aircraft.

During the Post Flight Inspection, Blower Fan Part No EVT3454HC was found unserviceable. There was no other damage observed on the aircraft.

1.4 Other Damage.

Nil

1.5 Personnel Information.

1.5.1 Pilot – in – Command.

Age : 30 Years
 License : ATPL
 Validity of License : 29.01.2022
 Validity of Medical : 02.07.2020
 Validity of FRTOL : 28.10.2022
 Total Flying Experience : 3643:02 Hrs
 Total Flying Experience on Type : 1423:02 Hrs
 Last Flown on Type : 19.11.2019
 Total flying experience during last 6 Months : 187.05 Hrs
 Total flying experience during last 30 days : 51.58 Hrs
 Total flying experience during last 24 Hours : 4:14 Hrs

1.5.2 Co-Pilot.

Age : 27 Years
 License : CPL
 Validity of License : 17.10.2024
 Validity of Medical : 19.08.2020
 Validity of FRTOL : 20.02.2024
 Total Flying Experience : 2010:26 Hrs
 Total Flying Experience on Type : 270:08 Hrs
 Last Flown on Type : 17.11.2019
 Total flying experience during last 6 Months : 270:08 Hrs
 Total flying experience during last 30 days : 39:06 Hrs
 Total flying experience during last 24 Hours : 6:58 Hrs

1.6 Aircraft Information.

1.6.1 A-320 Aircraft Air Conditioning System Overview.

A320 aircraft is equipped with an air conditioning system which maintains the air at a correct pressure and temperature in the pressurized fuselage compartments, and performs the following functions:-

- cabin temperature control,
- pressurization control,
- avionics ventilation,
- cargo compartment ventilation & heating (optional).

Cabin Temperature Control

The aircraft has two air conditioning packs installed in the wing root area, forward of the landing gear bay. The air conditioning packs are known as Pack 1 and Pack 2 and supply conditioned air to the cabin for air conditioning, ventilation and pressurization.

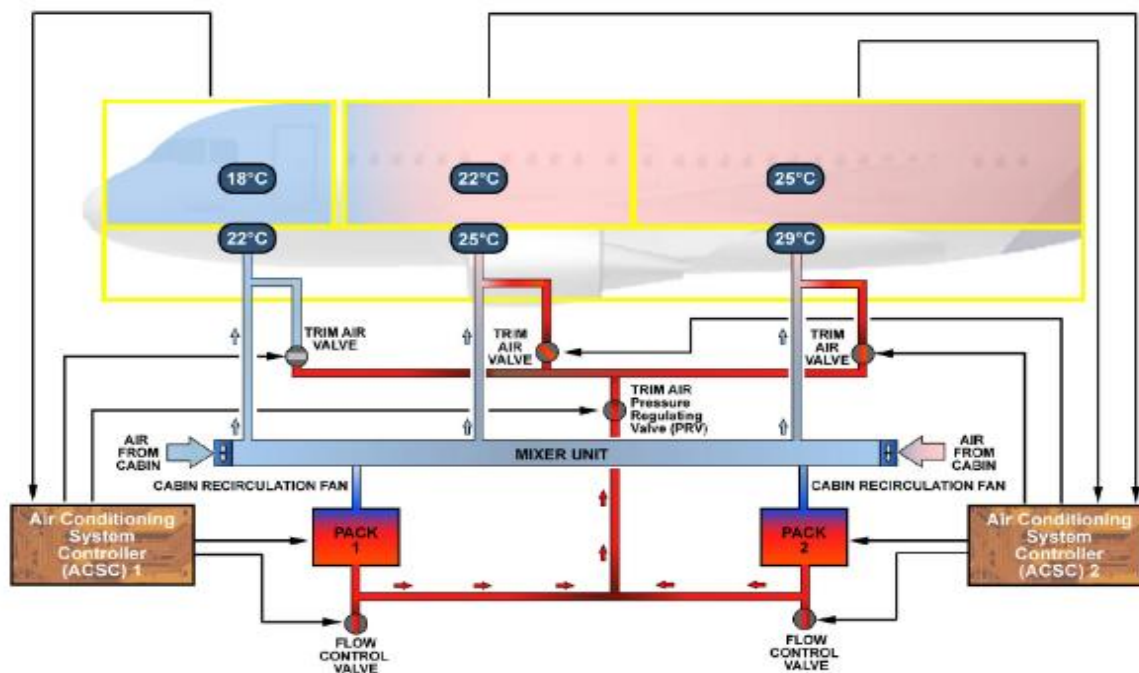


Fig. 1: Airconditioning System

The Air conditioning packs primarily consists of an air cycle machine. The Air Conditioning Packs are supplied hot air through the Pack Flow Control Valve (FCV). The flow rate through the Pack is adjusted by the FCV and it also acts as the Pack Shut-off Valve. FCV is controlled by the Air Conditioning System Controller (ACSC) based on the flow mass demand calculated by the ACSC. ACSC controls and monitors temperature regulation system for cabin zones based on temperature setting selected by the crew on overhead 'AIR COND' panel by modulating Bypass Valve and RAM Air Inlet.

There are two ACSCs available, each of which controls one Air conditioning Pack. The air from the Packs is supplied to the mixer unit. Two cabin recirculation fans draw the cabin air, which enters the underfloor area through recirculation filters and sends it to the mixer unit so that the demand for bleed air is reduced. The mixer unit supplies Cockpit, Forward Cabin and Aft Cabin. Normally, the mixer unit allows the supply to the cockpit from Pack 1 and supply to FWD and AFT cabins from Pack 2. The mixer unit mixes air from the packs and recirculated air from the cabin before distribution to each zone.

ACSC controls the trim air Pressure Regulating Valve (PRV) and trim air valves and hot air from the system is mixed with into the mixer unit discharge to increase the temperature in cabin.

Pressurization Control

The air from Airconditioning Packs is also used for supplying air for pressurising the cockpit, the avionics bay, the cabin and the cargo compartments to maintain the cabin altitude and rate of climb for maximum passenger safety and comfort. The outflow valve adjusts the quantity of air that is released from pressurised cabin.

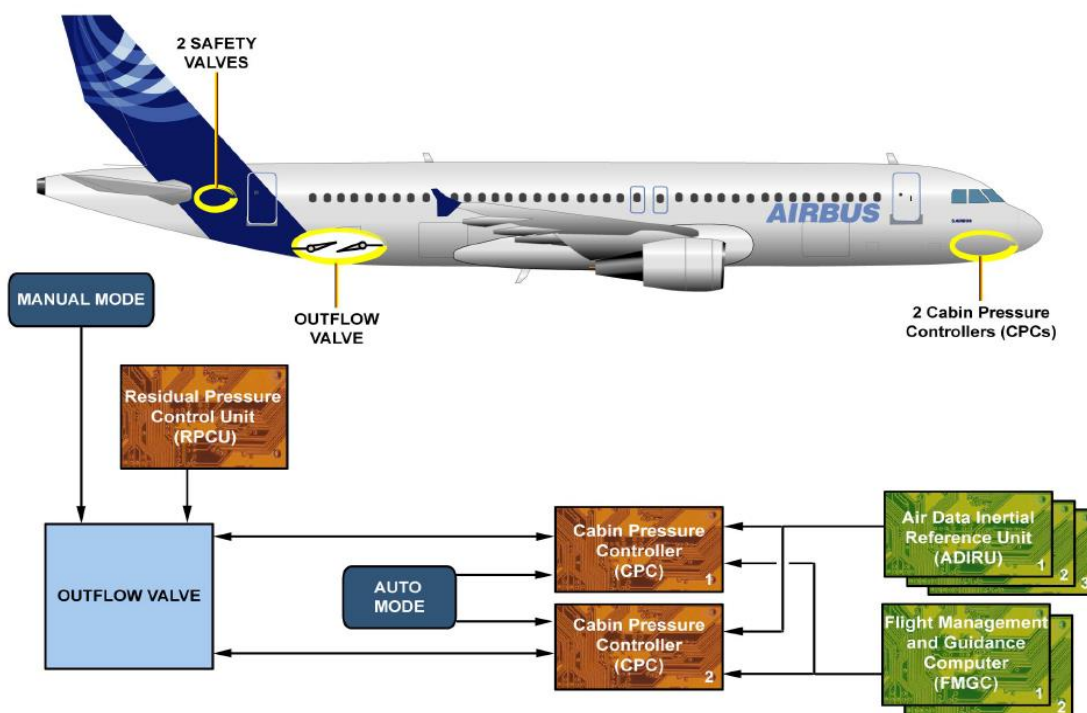


Fig. 2: Pressurisation Control

There are two automatic pressurisation systems comprising two outflow valves which are controlled by two separate Cabin Pressure Controllers (CPC). Only one system operates at a time with the other system acting as backup in case of a failure. The outflow valves can also be operated manually in case of failure of automatic system.

Two safety valves are installed on the rear pressure bulkhead to protect the fuselage against excessive cabin differential pressure and negative differential pressure. The Residual Pressure Control Unit (RPCU) prevents residual pressure in the cabin and takes over the control of the outflow valve automatically. To do this, it supplies power directly to the manual motor of the outflow valve.

Avionics Ventilation

Cooling air to the avionics equipment in avionics compartment, flight deck instruments and circuit breaker panels is supplied by the Avionics Ventilation System. A blower Fan and an Extraction Fan circulate the air through the avionics compartment, and remain in continuous operation when aircraft electrical system is powered.

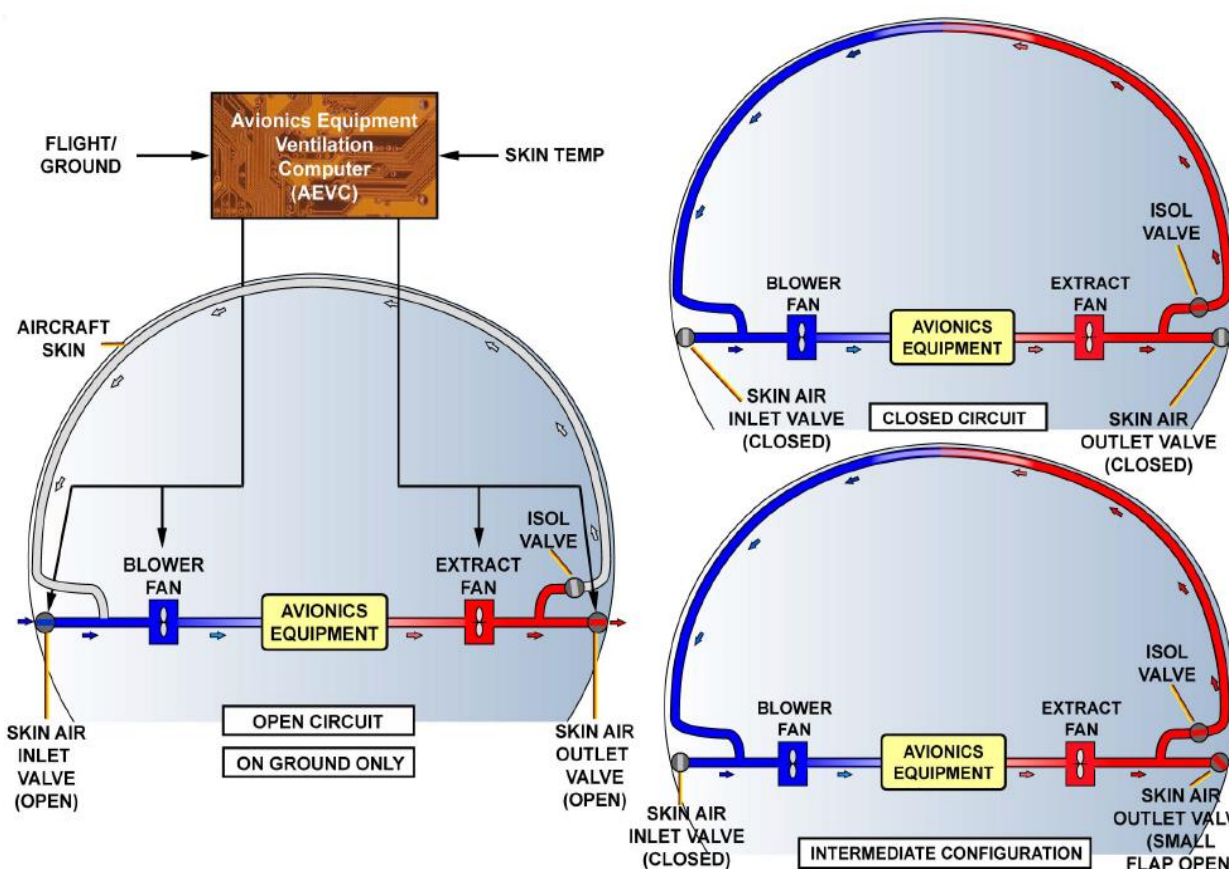


Fig. 3: Skin Air Inlet and Outlet Valves Configurations

The Avionics Equipment Ventilation Computer (AEVC) controls the fans and the configuration of the skin valves in the avionics ventilation system based on flight / ground logic and fuselage skin temperature. There are three configurations for Skin Air Inlet and Outlet Valves.

- open circuit: the Skin Air Inlet and Outlet Valves are open (on ground only),
- closed circuit: the Skin Air Inlet and Outlet Valves are closed
- intermediate circuit: the inlet is closed and the outlet is open, but not fully.

Open Circuit Configuration

In the Open Circuit Configuration (Fig. 4), the Skin Air Inlet and Outlet Valves are in open condition. Blower Fan blows the ambient air drawn from Skin Air Inlet Valve into the system. The air cools the avionics equipment and is extracted by the Extraction Fan and thrown overboard. The open circuit configuration allows the avionics equipment to be cooled with ambient air under certain conditions. (On ground and skin temperature above 12°C (53,6°F) increasing, or above 9°C (48,2°F) decreasing).

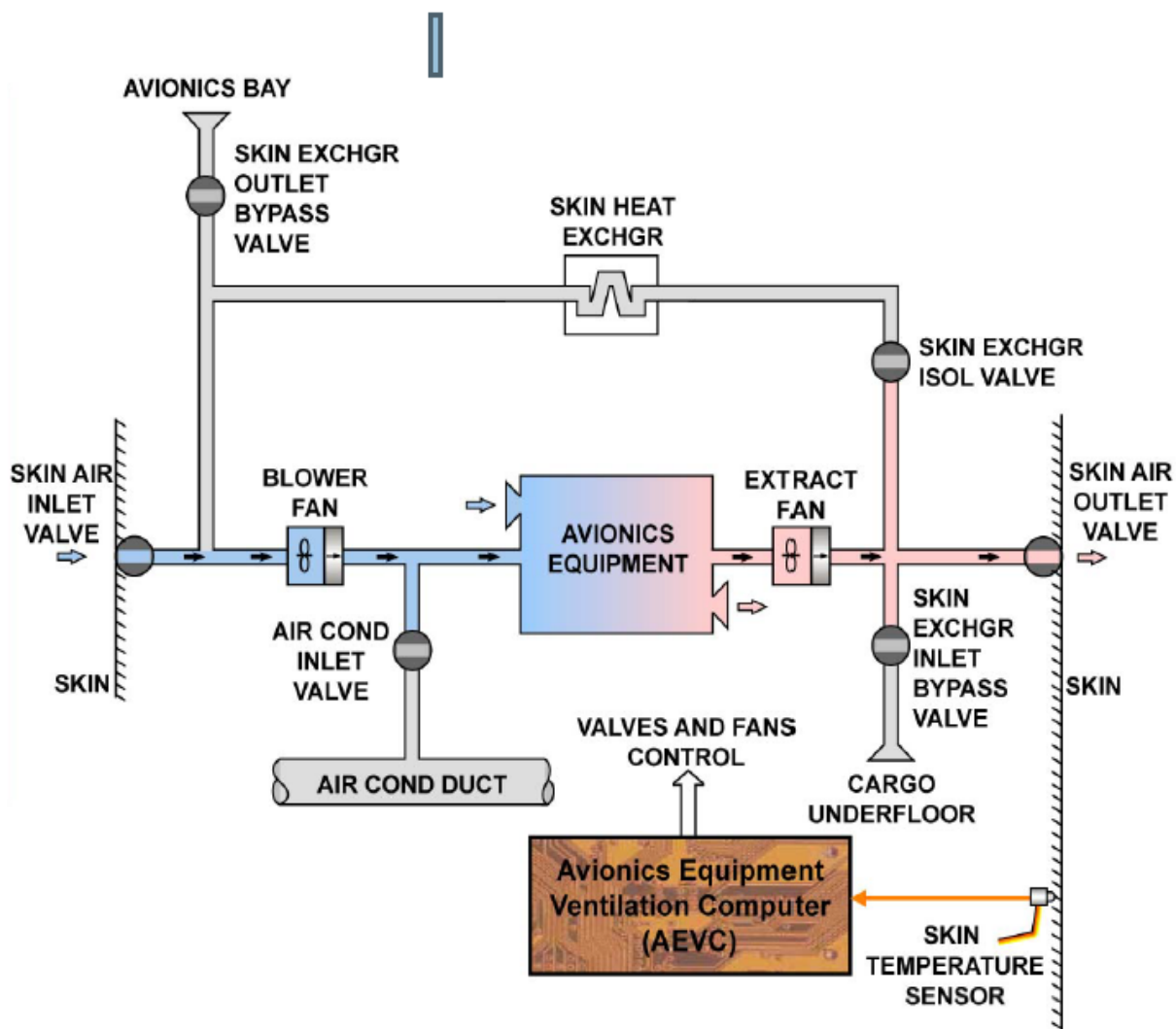


Fig. 4: Open Circuit Configuration

Closed Circuit Configuration

In the Closed Circuit Configuration (Fig. 5), the Skin Air Inlet and Outlet Valves are closed. The Extraction Fan extracts the air from the avionics equipment and blows it into the Skin Heat Exchanger through the Skin Exchanger Isolation Valve to be cooled. This air is then blown over the Avionics Equipment again. The extracted air may be discharged through Skin Exchanger Inlet Bypass Valve into the FWD cargo compartment.

The skin exchanger inlet bypass valve is controlled by the AEVC in accordance to the system configuration to discharge the air under the FWD cargo compartment. The skin exchanger outlet bypass valve opens in order to decrease the noise level in the avionics bay.

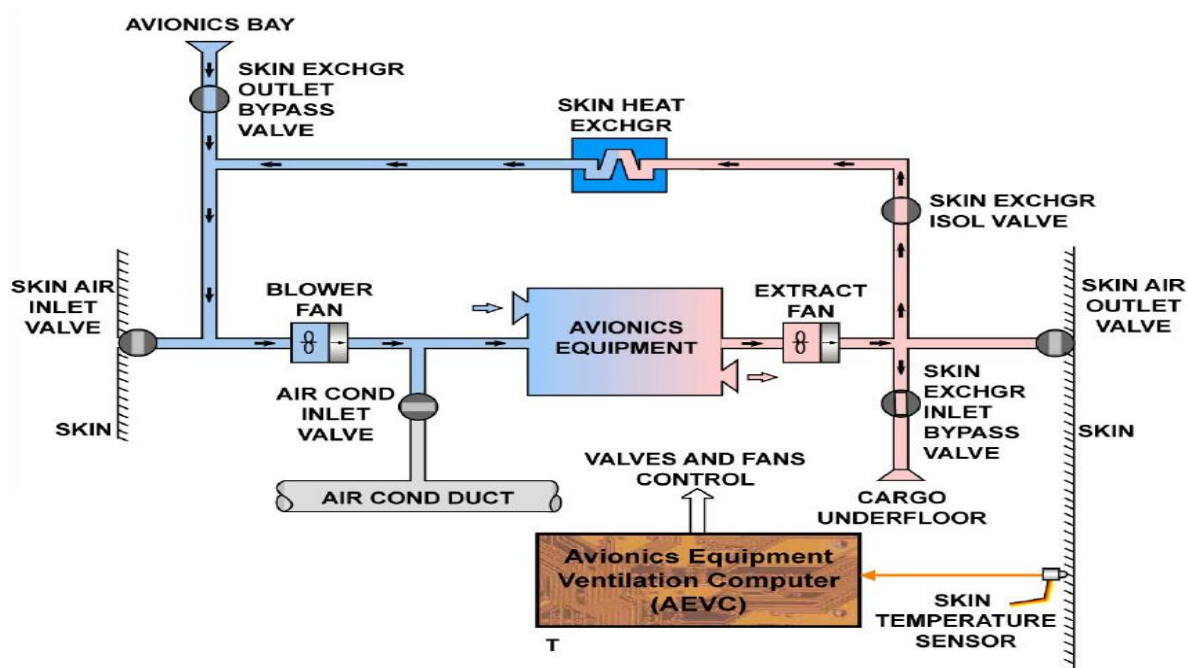


Fig. 5: Closed Circuit Configuration

Partially Open Circuit Configuration

In partially open circuit configuration, the system is almost like in closed configuration, part of the extracted air is expelled overboard.

Cargo Ventilation and Heating

Cargo Ventilation and Heating system is an optional system.

1.6.2 Aircraft Maintenance.

Aircraft VT-ITB bears Serial No. 6720 and was manufactured in year 2016. The aircraft is registered with DGCA under the ownership of M/s Avolon Aerospace (Ireland) AOE 50 Limited under Category 'A' and issued Certificate of registration No. 4697.

The Certificate of Airworthiness Number 6807 under "Normal category" and subdivision "Passenger / Mail / Goods" was issued by DGCA and is valid subject to the validity of Airworthiness Review Certificate or unless suspended/cancelled by DGCA. The Airworthiness Review Certificate was valid up to 22.09.2019. As on 15.08.2019, the aircraft had logged 11015:06 Airframe Hours, and the Aero Mobile License of the aircraft is valid up to 30.11.2021.

The aircraft and its engines are being maintained as per the maintenance program consisting of Calendar Period/ Flying Hours or Cycles based maintenance as per maintenance program approved by DGCA. The last major inspection, 700FH/90 Days was certified on 15.08.2019. Subsequently, all lower inspections (Pre-flight checks, Service Checks, Weekly Checks) were carried out as and when due before the incident.

As per the approved weight schedule, the empty weight of the aircraft is 39610.450 Kgs. Maximum usable fuel Quantity is 18622 Kgs. Maximum pay load with fuel tanks full is 11670.305 Kgs and Empty weight CG is 23.882% MAC. The next weighing was due on 12.09.2021.

All applicable Airworthiness Directives, mandatory Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engines had been complied with as on date of incident.

The aircraft is equipped with Pratt and Whitney Engine PW1127G-JM. The left engine S/N P770590 was manufactured on 27.07.2018 and had logged 3932 Hrs. as on 15.08.2019. The last major inspection carried out on LH Engine was 750H/90 Days check which was certified on 15.08.2019.

The right engine S/N P770439 was manufactured on 11.08.2017 and had logged 2854:15 Hrs. as on 15.08.2019. The last major inspection carried out on RH Engine was 750H/90 Days check which was certified on 15.08.2019

1.6.3 Aircraft Post Flight.

After arrival, the AME reviewed the Pilot Flight Report and carried out inspection and rectification action on aircraft. ECAM warning 'Vent Blower Fault' had appeared at 1118 UTC as per the Post Flight Report obtained from the aircraft.

AEVC test was carried out and Vent Blower fan was found to be faulty. Rumbling sound and smell in cockpit were observed during its operation. The faulty Fan was removed from the aircraft and replaced with a serviceable unit. The details of failed Blower Fan are as below: -

Part No. : EVT3454HC
Sr. No. : 164906094
TSN/TSI : 11015/11015 HRS.

The Avionics Vent Filter cartridge was found dirty and was also replaced with new unit. No Engine fault was reported by the crew. Physical inspection of Engine was carried out and Magnetic Chip report was generated which was found to be satisfactory. Engine Ground Run was given and no smell, or smoke was observed post rectification and aircraft was released for service.

1.7 Meteorological Information.

No information obtained.

1.8 Aids to Navigation.

No information obtained.

1.9 Communications.

Aircraft maintained a positive contact with ATC throughout the flight. Copies of Tape transcript for VHF Frequencies 128.1Mhz, 120.95Mhz, 120.25Mhz, 118.45Mhz, and 121.85Mhz were obtained.

ATC Hyderabad had also contacted with Dundigal ATC, Hakimpet ATC and Bidar ATC in Indian Air Force airspace to co-ordinate descent of aircraft below FL100.

1.10 Aerodrome Information.

Hyderabad aerodrome is known as Rajiv Gandhi International Airport and is operated by Hyderabad International Airport Limited. The ICAO code for the aerodrome is VOHS and IATA code is HYD. The ARP co-ordinates of the aerodrome is 17° 14' 26" N 78° 25' 44" E and elevation of aerodrome is 2024 feet. Both IFR and VFR traffic is permitted at the aerodrome. The details of Runway available at Hyderabad Aerodrome are given below : -

Designations RWY	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY
09L	3707 x 45	77/F/B/W/T
27R	3707 x 45	77/F/B/W/T
09R	4260 x 60	77/F/B/W/T & 88/R/C/W/T
27L	4260 x 60	77/F/B/W/T & 88/R/C/W/T

Aerodrome has Category 09 Rescue and Firefighting Facility available which can be upgraded to Category 10 with a notice of 24 Hrs. ATS services are provided by Airport Authority of India and details of ATS communication facilities are given below: -

Service designation	Call sign	Frequency	Hours of operation	Remarks
Clearance Delivery	----	121.625 MHZ		5NM Coverage
Area Control	Hyderabad Control/ Radar	120.95 MHZ	H24	75NM Coverage
		128.35 MHZ	H24	75NM Coverage
Tower	Shamshabad TWR	118.45 MHZ	H24	25 NM coverage
ATIS	----	126.475 MHZ	H24	75NM Coverage
Emergency	----	121.5 MHZ	H24	75NM Coverage
Approach/ Radar	Hyderabad APP/Radar	120.25 MHZ	H24	75NM Coverage
		125.55 MHZ	H24	75NM Coverage
SMC	Shamshabad GND	121.85 MHZ	H24	5NM coverage

1.11 Flight Recorders.

The aircraft was equipped with a CVR and DFDR. CVR recording was obtained from the airline operator and analysed. The recordings were audible but contained sound disturbance caused by the crew donning Oxygen Mask.

The mixed channel file of 02:05:06 Hrs was downloaded and analysed. The recording from the CVR was synchronised with the ATC transcript

CVR Elapsed Time (Hrs)	UTC (Appox.)	Event
01:28:30	11:18:17	Cabin Crew confirms presence of Smoke in cabin.
01:29:04	11:18:41	Crew dons Oxygen Mask
01:29:09	11:18:46	Crew calls for putting Vent BLOWER in OVRD (Override) while carrying out ECAM actions.
01:30:09	11:19:46	Crew discuss about carrying Smoke Procedures
01:30:50	11:20:27	Crew calls for putting Vent BLOWER in OVRD.
01:30:54	11:20:31	Crew calls for putting Vent EXTRACT in OVRD.
01:31:59	11:21:36	Crew declares 'MAYDAY'.

1.12 Wreckage and Impact Information.

Nil

1.13 Medical and Pathological Information.

Nil

1.14 Fire.

No indication or signs of fire were observed on aircraft or its engines.

1.15 Survival Aspects.

The incident was survivable.

1.16 Tests and Research.

Nil

1.17 Organizational and Management Information.

M/s Indigo is a Scheduled Airline Operator with its main base at IGI Airport, New Delhi. It started its operation in 2006. Presently it is operating Domestic and International sectors with a fleet of about 250 aircraft consisting of A-320, A-321 and ATR. The company is headed by a Chief Executive Officer who is assisted by various professionals. The maintenance of the aircraft is carried out under CAR 145 approval.

1.18 Additional Information.**1.18.1 Avionics Fan.**

Avionics Fan PN EVT3454H was installed in the A320 Family Avionics Ventilation System in the blower and extract positions. Even though the part had worldwide Guaranteed Mean Time Between Unscheduled Removals (GMTBUR) of 18000FH, a number of premature Fan failures were caused by degradation/failure of steel bearings which would cause a strong rumbling noise under the cabin/cockpit floor and frictional burning smell within the cockpit.

OEM had issued a Vendor Service Bulletin (VSB ref. 3454-21-108) for installation of new ceramic bearings to address the issue concerning the failure of steel bearings in Fan PN EVT3454H. The Vendor Service Bulletin (VSB ref. 3454-21-108) has been issued by the OEM, to resolve the issue concerning the failure of bearings in Fan part number

EVT3454H. New Ceramic Bearing was introduced and the fan part number evolved from PN EVT3454H to PN EVT3454HC.

At present none of the aircraft in fleet of M/s Indigo is equipped with Avionics Fan PN EVT3454H; and PN EVT3454HC has achieved GMTBUR of approximately 22000FH. OEM has also introduced a new standard of Avionics Fan PN AE1819B00 and as of now 38 aircrafts in Indigo's Fleet are equipped with this part. The reliability of PN AE1819B00 is being studied by Indigo Airlines.

A Ball Bearing Health Monitoring system has also been introduced by OEM with Avionics Fan PN EVT3454HM01, however, none of the aircraft in Indigo's Fleet is presently equipped with this system.

During the period 2016-2019, six cases of failure of Avionics fan PN EVT3454HC were reported in the Indigo's fleet; where the aircraft had diverted, made an Air Turn Back or carried out an emergency landing owing to perceptible smoke in cockpit caused by the failure of Avionics Fan.

1.18.2 Vent Blower/Extract Fault.

In case of failure of any of the two avionics ventilation fans, VENT BLOWER FAULT or a VENT EXTRACT FAULT warning is generated on the ECAM. The snapshot of the warning simulated on ground is shown in the Fig. 6 below.



Fig. 6: Vent Blower Fault

The warning will continue till it is cleared by the crew. In case of failure of either Blower or Extract Fan, dispatch under MEL is also allowed. In case of Blower/Extract fault alert, the ECAM procedures calls for BLOWER or the EXTRACT pushbutton switch to be set at the OVRD (override) position. This will stop the concerned fan and the system will be in closed-circuit configuration while adding air from the air conditioning system to the ventilation air.

In case of smoke, the Quick Reference Handbook (QRH) action calls for both the BLOWER and the EXTRACT pushbuttons to be set to the OVRD position. In this case, the air conditioning system supplies cooling air which is then exhausted overboard so that any smoke in the system is cleared.

1.19 Useful or Effective Investigation Techniques.

Nil

2. ANALYSIS.

2.1 Serviceability of the aircraft.

The aircraft had a valid Certificate of Airworthiness on the date of incident. The last major inspection on the aircraft was carried out at in Aug 2019. Aircraft did not have any pending snag and was neither operating under any MEL.

Both engines were serviceable and did not have any pending snags. Aircraft was maintained as per the approved program and was airworthy on the date of accident. The aircraft had clocked 11015:06 Hrs on 15.08.2019.

During the Post Flight Inspection, it was found that the Blower Fan of the Avionics Ventilation System had failed. The rumbling sound was observed from the fan during operation and burning smell was observed in the cockpit and cabin. All Engine parameters were observed to be normal and post flight inspection did not reveal any problem with the engines. Failure of Blower Fan PN EVT3454HC was the primary factor in of the incident.

2.2 Crew Actions.

As the crew observed rumbling noise in the cockpit, they immediately suspected Engine failure. When they heard thud noise and smelled smoke, the perception grew stronger. Crew observed all Engine parameters to be normal and carried out the

necessary ECAM actions. Crew is heard in the CVR calling for the BLOWER pushbutton to be put on OVRD (override) position at 11:18:46 UTC. This action stopped the Blower fan operation but did not allow the smoke/smell to dissipate as the Avionics Ventilation System remained in a closed-circuit configuration. In close-circuit configuration, the extracted air gets discharged to the Cargo compartment, through the Skin Air Inlet Bypass Valve. This air which would have contained perceptible smoke got re-circulated into the Mixer Unit supplying air to the Cabin, and hence Cabin Crew could also smell smoke in the Cabin.

At 11:20:31 UTC while carrying out the Smoke Procedures, crew is heard calling for putting both BLOWER and EXTRACT pushbutton to OVRD position in CVR Recording. This had put the Avionics Ventilation System in an open-circuit configuration and allowed for dissipation of smoke and smell as the air was discharged overboard through Skin Air Outlet Valve.

Crew had ignored the fact that Blower Fan has failed and could be a cause of perceptible smoke in cockpit and continued to suspect Engine as the smoke/smell persisted for more than expected.

3. CONCLUSIONS.

3.1 Findings.

3.1.1 Aircraft was equipped with Blower Fan PN EVT3454HC. The said part has worldwide GMTBUR of approximately 22000 Hrs.

3.1.2 Six incidents of Air Turn Back, Diversion and Emergency Landing have been reported in Indigo Airlines during 2016-2019 and all these aircraft were equipped with PN EVT3454HC.

3.1.3 OEM has introduced new Design PN EVT3454HM01 and Ball Bearing Health Monitoring system to further improve reliability of Blower Fan.

3.1.4 Failure of Blower Fan does not cause serious safety concern and aircraft can safely land or be despatched under MEL.

3.1.5 Aircraft Crew were aware of failure of Blower Fan but were suspecting smoke from Engine even though all Engine Parameters were normal.

3.1.6 During post flight maintenance, no fault was found in the engine and aircraft was released for flight by AAIB team the very same morning after replacement of Blower Fan which had failed.

3.2 Probable Cause of the Incident.

The incident was caused by failure of Blower Fan of aircraft's Avionics Ventilation System.

4. SAFETY RECOMMENDATIONS.

4.1 Operator may carry out a reliability study of PN AE1819B00 to assess the feasibility of introducing modified Fan EVT3454HM01 with BBHM system.



(Jasbir Singh Larhga)
Deputy Director Air Safety
Aircraft Accident Investigation Bureau

Date: 01.01.2020