

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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FINAL REPORT ON SERIOUS INCIDENT INVOLVING M/s JETAIRWAYS'

ATR 72-500 AIRCRAFT VT-JCN AT INDORE ON 06.12.2018

1. Aircraft Type : ATR 72-500
Nationality : INDIAN
Registration : VT – JCN
2. Owner : M/s Constellation Aircraft Leasing Limited
3. Operator : Jet Airways.
4. Pilot – in –Command : ATPL holder on type,
Extent of injuries : Nil
5. First Officer : CPL Holder on type,
Extent of injuries : Nil
6. Place of Incident : Indore Airport
7. Date & Time of Incident : 6th Dec 2018, 1537 UTC
8. Last point of Departure : Indore
9. Point of intended landing : Delhi
10. Type of operation : Scheduled Operation
11. Crew on Board : 04
Extent of injuries : Nil
12. Passengers on Board : 66
Extent of injuries : Nil
13. Phase of operation : Climb
14. Type of incident : Air Turn Back due to Engine fire

(ALL TIMINGS IN THE REPORT ARE IN UTC)

SUMMARY

M/s Jet Airways ATR 72-500 aircraft VT-JCN was involved in an Air Turn Back due to RH engine fire warning in cockpit while operating Flight 9W-794 from Indore to Delhi on 06.12.2018. There were 66 passengers on board. There was no injury reported to any of the occupants.

Aircraft took off from Indore at 1515 UTC for Delhi. Take off and initial climb were uneventful. But RH Engine fire warning was observed by crew while the aircraft was passing FL 150. The fire was contained by discharge of a single squib. Crew declared "MAYDAY" to Nagpur ATC and decided to turn back to Indore.

Indore ATC was informed by the Nagpur ATC as well as an overflying aircraft of the emergency. All the emergency services were activated and full emergency was declared at Indore airport. Aircraft landed safely on Runway 25 at 1607 UTC. Normal disembarkation of passengers was carried out at the parking bay and no injury was reported to any passenger or crew.

Occurrence was classified as Serious Incident as per the Aircraft (Investigation of Accidents and Incidents) Rules, 2017. Aircraft Accident Investigation Bureau vide its Order-Serious Incident dated 17th Dec, 2018 appointed Mr. Jasbir Singh Larhga, Assistant Director as an Investigator-in-Charge and Mr. Dinesh Kumar, Air Safety Officer as an Investigator.

Initial notification of the occurrence was sent to ICAO, Transport Safety Board of Canada and Bureau d'Enquêtes et d'Analyses (BEA), France on 18th Dec 2018 as per requirement of ICAO Annex 13.

1 FACTUAL INFORMATION

1.1 History of the Flight

On 06.12.2018, M/s Jet Airways ATR 72-500 aircraft VT-JCN was scheduled to operate Flight 9W-794 on Indore – Delhi sector. The flight was under command of an ATPL holder pilot, with a CPL holder pilot as Co-Pilot. There were 66 passengers and 04 crew on board, which included the 02 cabin crew. Total take-off weight was 21205 Kgs.

The crew had earlier in the day operated three flights (Flight 9W709, 9W705 and 9W707) on VT-JCN, before operating Flight 9W-794. All three earlier flights were uneventful. Crew had not observed any abnormal parameter during any of these flights. The scheduled departure for Flight 9W-794 from Indore was 1525 UTC. Boarding of passengers commenced at 1435 UTC and was accomplished at 1510 UTC with aircraft door being closed at 1511 UTC. After clearance from Indore ATC, aircraft took off at 1515 UTC from Runway 25 and attained the assigned flight level 150 (FL150).

While passing FL150 for climb to FL180 and at a distance of 76 NM away from Indore, the crew observed RH Engine Fire warning in the cockpit. Immediately thereafter, PIC who was Pilot-Monitoring (PM) took over control from the Co-Pilot who was Pilot-Flying (PF). Emergency Checklist was carried out and one squib was discharged to extinguish the fire. Crew was in contact of Nagpur ATC and 'MAYDAY' was declared at 1537 UTC.

The cabin crew was also alerted by a passenger seated at 11D about flames from the RH Engine. The Cabin Crew informed the PIC of the same and was instructed by PIC to be on standby. Cabin Crew later noticed that flames had subsided.

Nagpur ATC called Indore ATC on hotline at 1539 UTC and enquired about POB and aircraft endurance. Indore ATC was also informed of emergency on VT-JCN. Later at 1542 UTC, Nagpur ATC informed Indore ATC on the hotline that VT-JCN would be returning to Indore. An overflying aircraft also contacted Indore ATC at 1543 UTC to inform that VT-JCN shall be returning to Indore, due to Engine Fire.

A full emergency was declared by Indore ATC and all departures were put on hold. Fire Tender along with Ambulance were positioned on Taxiway ‘B’ and Taxiway ‘F’ after receiving information about the “MAYDAY” aircraft.

VT-JCN came in contact with Indore ATC at 1545 UTC confirming “*Jet Airways on fire, landing in Indore*” and informed Indore ATC that ETA would be 1603 UTC. PIC also informed that the fire was contained, and that they are operating on a single engine.

At 1546 UTC, crew reported position “*65 DME inbound Indore and maintaining FL100*” and were given clearance for Runway 25. Aircraft landed at Indore on Runway 25 at 1607 UTC. Crew requested no assistance and aircraft vacated the runway via “Taxiway C - Taxiway A” for Parking Stand No. 8. Normal disembarking of passengers was carried out at about 1621 UTC and no injury was reported to any passenger or crew. Full Emergency at Indore Airport was withdrawn at 1633 UTC.

1.2 Injuries to Persons

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
MINOR/NONE	04	66	Nil

1.3 Damage to Aircraft

Apart from the damage to engine due to fire, the aircraft did not receive any other damage. During post flight inspection the following damages were found on the Engine.

- (i) Rubbing Marks on Impeller tip and oil stains were found on aerofoil surface.
- (ii) No. 6 and No. 7 Oil Scavenge Tube were found broken with engine oil splashed on the bottom cowling (Figure 1).



Figure 1

- (iii) Thirteen Power Turbine (PT2) Blades were found damaged (Figure 2).
- (iv) Turbine Casing was cracked (Figure 2).



Figure 2

- (v) Damage was observed on Breather Tube Outlet with some material missing (Figure 2).

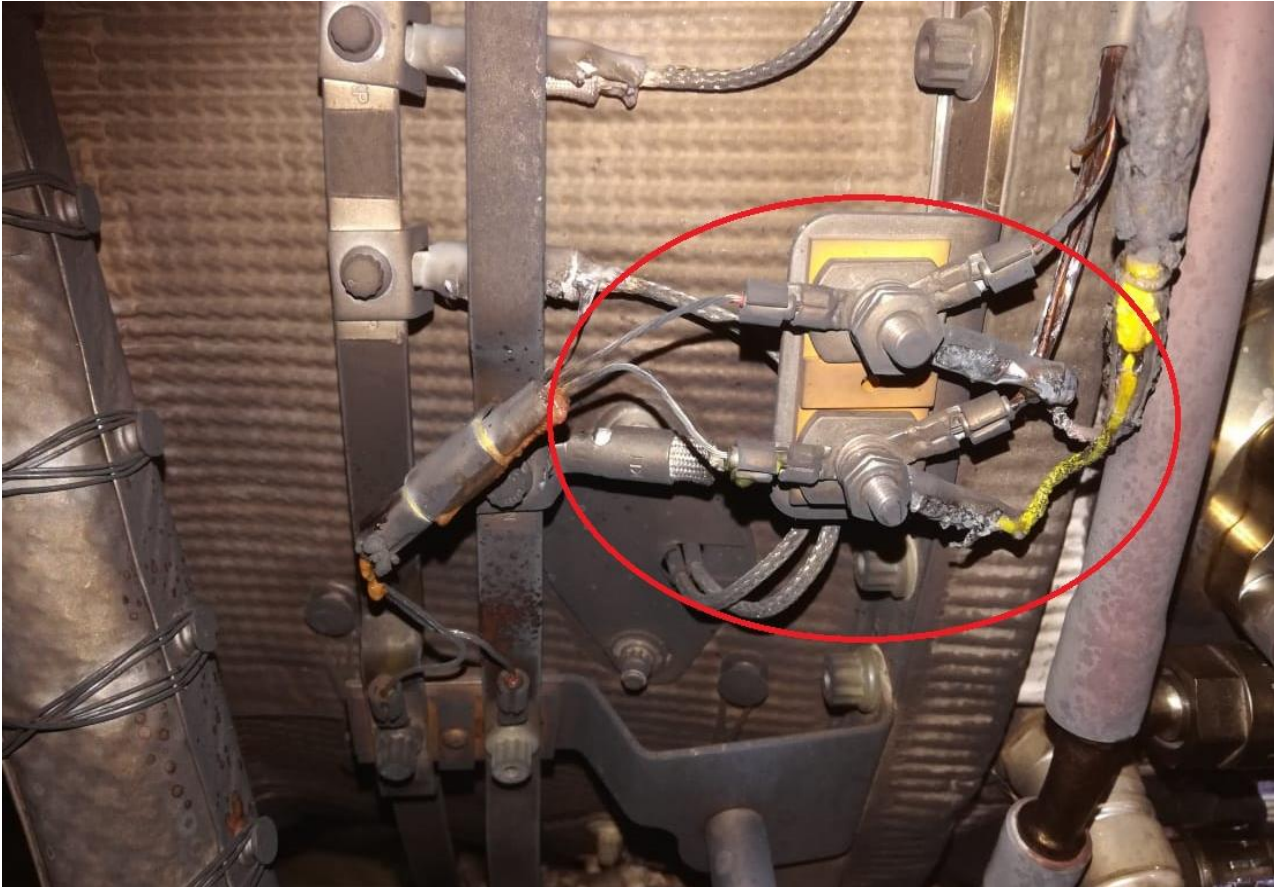


Figure 3

(vi) QEC#3 Harness was found burned near ITT thermocouple junction (Figure 3).

Boroscope Inspection of the damaged engine was carried out as per PWMM72-00-00 and findings are enumerated below:-

1. Leading edge coating erosion on all HPT blades was observed.
2. LPT blades were found satisfactory.
3. PT Stage 1 was found satisfactory.
4. Coating was found missing on inner liner of combustion chamber, exposing parent metal but without forming a hole.
5. Rubbing marks were found on impeller tip and casing of LP impeller with dried oil stains on vane surface.

All observations were within the limits prescribed in the Maintenance Manual. The aircraft was put back into service after Engine change and necessary maintenance actions.

1.4 Other Damage

NIL

1.5 Personnel Information

1.5.1 Pilot – in – Command

Age : 39 years
License : ATPL
Date of Issue of License : 17/09/2011
Validity of License : 16/11/2020
Class I Medical Valid up to : 14/03/2019
Date of issue FRTOL License : 27/03/1998
FRTO License Valid up to : 16/09/2022
Endorsements as PIC : ATR 72 – 500/ 600
Total flying experience : 7500 Hrs
Total flying experience on type : 3500 Hrs
Total flying experience during last 1 year : 760 Hrs
Total flying experience during last 6 Months : 405 Hrs
Total flying experience during last 30 days : 49 Hrs
Total flying experience during last 07 Days : 06 Hrs
Total flying experience during last 24 Hours : 03:38 Hrs
Rest period before flight : 23 Hrs

1.5.2 Co-Pilot

Age : 27 years
License : CPL
Date of Issue of License : 18/09/2015
Validity of License : 17/09/2020
Class I Medical valid up to : 24/10/2019
Date of issue FRTOL License : 18/09/2015
FRTO License valid up to : 17/09/2020
Total flying experience : 1396:56 Hrs

Total flying experience on type	: 1193:56 Hrs
Total flying experience during last 1 year	: 708:51 Hrs
Total flying experience during last 6 Months	: 375:32 Hrs
Total flying experience during last 30 days	: 51:25 Hrs
Total flying experience during last 07 Days	: 22:38 Hrs
Total flying experience during last 24 Hours	: 09:13 Hrs
Rest period before flight	: 16:30 Hrs

Both operating crew were not involved in any serious incident/accident in the past. Both operating crew were current on all trainings and had adequate rest as per the Flight Duty Time Limitations (FDTL) requirement prior to operating the incident flight.

1.6 Aircraft Information

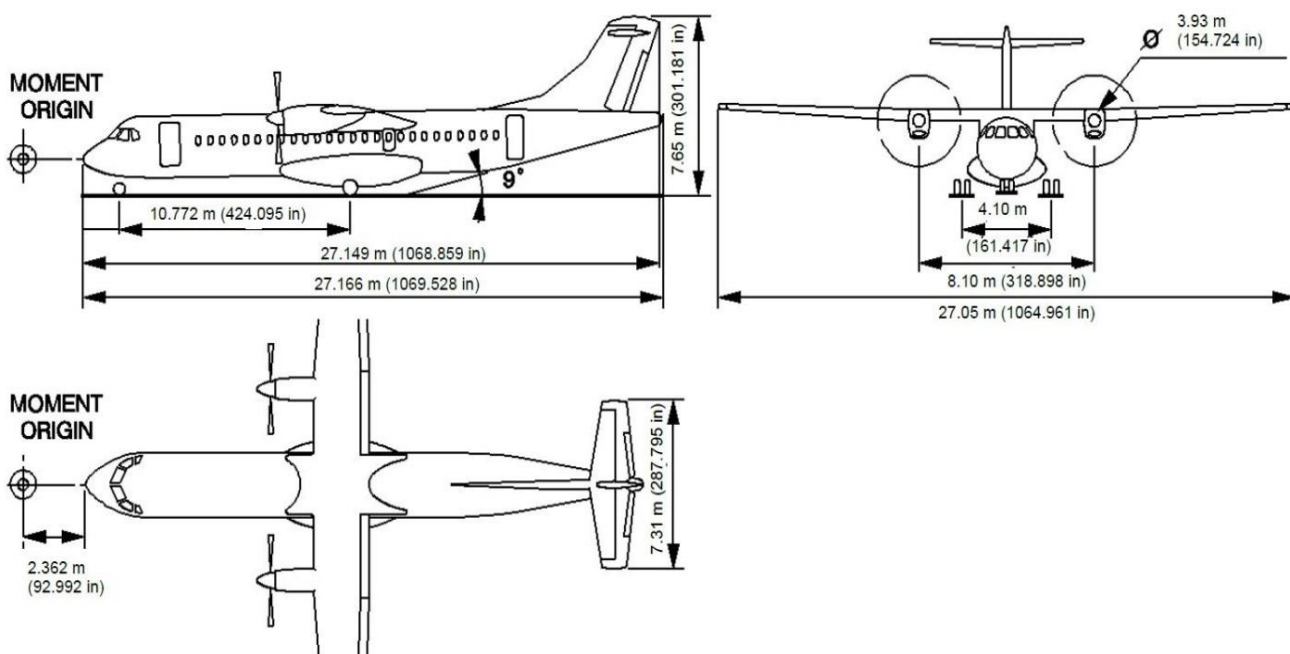


Figure 4

ATR-72 aircraft is certified in the Transport Category, JAR25 and ICAO Annex 16 for day and night operations. Minimum flight crew requirement is “two”. It can seat a maximum of 74 passengers as limited by emergency exit configuration. It has a length of 27.16 m and wingspan of 27.05 m. Wing reference area is 61m². Maximum permissible take-off weight is 22800 Kgs and maximum permissible landing weight is 22350 Kgs.

Aircraft is equipped with Pratt and Whitney PW127F turboprop engine. This engine is equipped with two centrifugal impellers driven by independent axial turbines, a reverse flow annular combustor and a two-stage power turbine which provides the drive for the reduction gearbox. The engine is primarily divided into two modules: a reduction gearbox module and a turbomachinery module. The modules are joined to form a rigid unit and provision is made for the installation of airframe equipment on the engines.

Aircraft VT-JCN (MSN 825) was manufactured in the year 2008. The aircraft is registered with DGCA under the ownership of M/s Constellation Aircraft Leasing Limited. The aircraft was registered under Category 'A' and issued a Certificate of Registration No. 3848/4 valid up to 14.10.2020.

The Certificate of Airworthiness No. 5057 under "Normal category" and subdivision "Passenger / Mail / Goods" was issued by DGCA on 15.10.2008. The Certificate of Airworthiness specifies minimum operating crew as "Two" and the maximum "All up Weight" as 22800 Kgs. The validity of the Certificate of Airworthiness is subject to the valid Airworthiness Review Certificate or unless suspended/cancelled by DGCA. The Airworthiness Review Certificate was valid up to 15.10.2019.

The Aircraft held a valid Aero Mobile License No. A-006/034/WRLO-08 at the time of incident. This aircraft was operated under Air Operator Permit No S-6A which was issued on 31.10.2017. As on the day of incident, the aircraft had logged 29741:55 Airframe Hours.

The aircraft and its engines were being maintained as per the DGCA approved maintenance program. Accordingly, the last major inspection on aircraft was A060 Check which was carried out on 26.11.2018. Subsequently, all lower inspections (Pre-flight checks, Service Checks, Weekly Checks) were carried out as and when due.

The aircraft was last weighed on 29.05.2018. As per the approved weight schedule, the Empty weight of the aircraft is 13291.00 Kgs. Maximum usable fuel quantity is 5000.00 Kg. Maximum payload with fuel tanks full is 4121.00 Kgs. Empty weight CG is 14.00 meters aft of datum. As there has not been any major modification

affecting weight & balance since last weighing, hence the next weighing was due on 28.05.2023. Prior to the incident flight the weight and balance of the aircraft was well within the operating limits.

All concerned 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 was equipped with PW127F engines. The Left Engine S/N EB0007 was manufactured in March 2000 and had logged 39001 Hrs and 34176 cycles. The last major inspection was Hot Section Inspection in Aug 2017.

The Right Engine S/N EB0361 was manufactured in Sept 2007 and had logged 24798 Hrs and 22969 cycles on the day of incident. The last major inspection was Boroscope Inspection carried out on 12.05.2018. There were no defects reported on any of the engines during the previous flight.

1.7 Meteorological Information

The aircraft took off from Indore airport at 1515 UTC and landed back at 1607 UTC. The METAR obtained from Indore airport for the date of incident from 1530 UTC to 1600 UTC is quoted below: -

Time (IST)	1530 UTC	1600 UTC
Wind	070°/03 Knots	080°/03 Knots
Visibility	3000 meters	3000 meters
Clouds	NSC	NSC
Temperature	21 °C	21 °C
Dew Point	14 °C	14 °C
QNH	1015 hPa	1015 hPa
QFE	949 hPa	950 hPa

The METAR indicated visibility of 03 km from 1530 UTC to 1600 UTC. The winds were consistent, with bearing 070° and velocity 03 kts. There were no significant clouds reported at the time of incident.

1.8 Aids to Navigation

Indore airport is equipped with following Radio Navigation and Landing Aids.

Type of aid CAT of ILS	ID	Frequency	Hrs of operation	Site of transmitting antenna Coordinates	Elevation of DME transmitting antenna	Remarks
DVOR	IID	116.7MHz	AS ATS	224238.2N 0754646.2E	---	---
DME (VOR)	IID	1138/ 1201MHz	DO	224322.1N 0754824.3E	561.7 m (1848 ft)	Collocated with VOR "IID"
NDB	ID	335 KHz	DO	224347.1N 0754836.3E	---	---
LLZ 25 ILS Cat. I	IHDR	110.9MHz	DO	224258.1N 0754719.3E	---	CW-TX1/TX2: 3.34/3.3°
GP 25 ---		330.08MHz	DO	224329.1N 0754835.3E	---	GP angle-TX1/TX2 : 2.99° / 3° RDH 53ft
DME (ILS)	IDR	1070/ 1007MHz	DO	224329.1N 0754835.3E	559.5 m (1836 ft)	collocated with GP 25

1.9 Communication

Details of various Channels on Aerodrome control and Approach control are as given below.

Service Designation	Call Sign	Frequency		Hours of operation
		Main	Alternate	
TWR	Indore Tower	122.8 MHz	118.50 MHz	As ATS
APP	Indore Approach	122.8 MHz	118.50 MHz	As ATS
DATIS	---	127.6 MHz		As ATS
Emergency Frequency		121.5 MHz		Available.

Aircraft maintained a positive communication with the ATC throughout the flight.

1.10 Aerodrome Information

Indore Airport is a public aerodrome which is operated and maintained by M/s Airports Authority of India. ICAO nomenclature for the airport is VAID. The geographical co-ordinates of the airport are 22° 43' 24" N and 075° 48'20" E. The elevation of the ARP is 561 m (AMSL). Both runways are 2754 m in length and 45 m in breadth. The orientation of the runway is 07/25. The detail of runway distances is as below;

Runway No.	Code	Elevation (Feet)	TORA (M)	TODA (M)	ASDA (M)	LDA (M)	RESA (M)
07	4D	1836	2754	2754	2754	2754	90 X 90
25	4D	1837	2754	2754	2754	2754	90 X 90

R/W & Taxi Tracks markings are standard as per Annex- 14 and Rescue & Firefighting Services of Category 8 are available. The layout of Indore aerodrome is shown in the figure 5 below: -

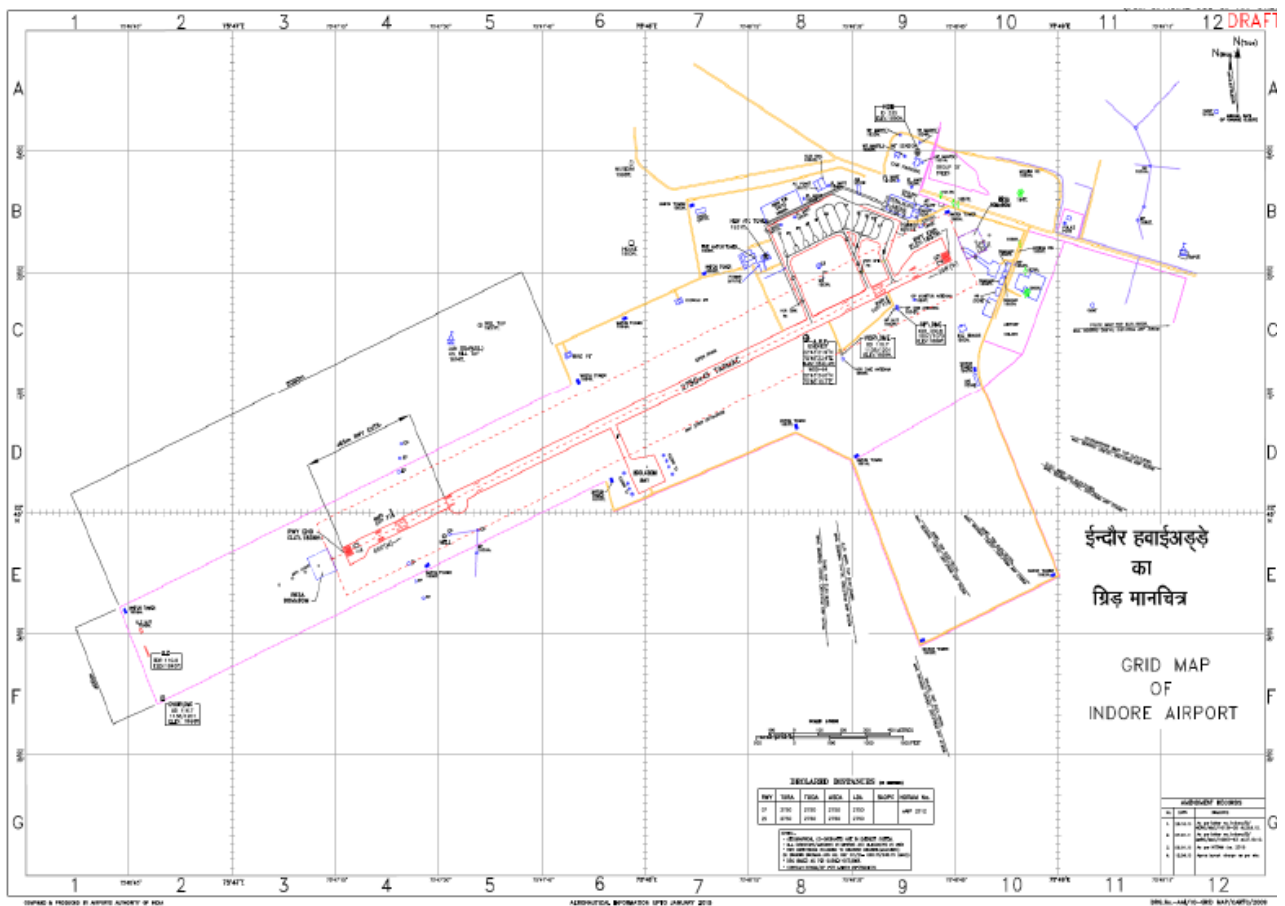


Figure 5

1.11 Flight Recorders

Aircraft was equipped with L3 Communication DFDR having part number 2100-4043-00 and Serial No. 000603289. The DFDR was removed from the aircraft post-incident and downloaded at CVR/FDR Lab of DGCA. As per the DFDR data, RH Engine was shut down at 15:14:42 UTC. The LH Engine continued to give normal power till touch down. The Engine N2 plot is given in Figure 4 below:-

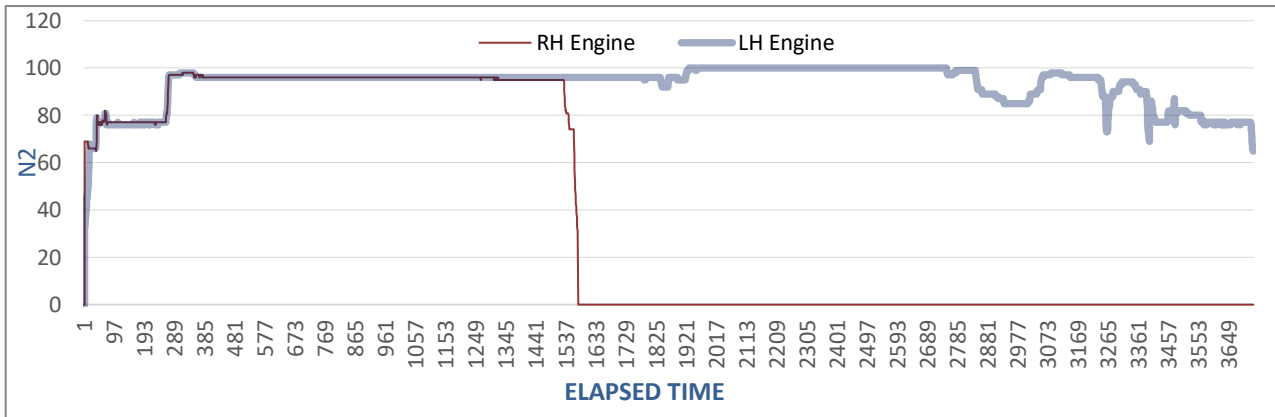


Figure 6

Aircraft was equipped with L3 Communication CVR. The part number of CVR was 2100-1020-02 and the serial number was 000542431. The CVR was also removed from the aircraft post-incident and complete download of the same was carried out at CVR/FDR Lab of DGCA.

1.12 Wreckage and Impact Information

The aircraft safely landed on Runway 25 with one engine inoperative, exited the runway under its own power and parked itself at Bay no. 08. Normal de-boarding of passengers was carried out.

Apart from damage to engine, no other damage was noticed on the aircraft.

1.13 Medical and Pathological Information

The crew had undergone pre-flight medical at Ahmedabad before operating the first flight of the day as per requirement of CAR Section 5, Series F, Part III. The results of the test were satisfactory. Post Flight medical examination was carried out at Indore and the same was also found satisfactory.

Further, none of the crew or passengers received any injury during flight or during de-boarding.

1.14 Fire

Fire was reported on the RH Engine during flight when aircraft was climbing to FL180. Crew followed the Emergency Checklist and one squib was discharged which successfully contained the Fire.

Fire Tenders and Ambulance were positioned at the Taxiway 'B' and Taxiway 'F' respectively as a full emergency was declared by the Indore Airport, however, aircraft did not need any assistance on landing and evacuated the runway under its own power.

1.15 Survival Aspects

The aircraft landed safely with a single engine operating and incident was survivable.

1.16 Tests and Research

NIL

1.17 Organisation and Management Information

M/s Jet Airways held a scheduled operator permit and was operating a fleet of 119 aircraft, comprising Boeing 777-300 ERs, Airbus A330-200/300, Boeing 737s and ATR 72-500/600s at the time of incident. The airline stopped operations in April 2019 owing to financial issues.

The aircraft and engine were leased from a lessor and the aircraft was deregistered by DGCA after the airlines ran into financial trouble. After being deregistered, the custody of the aircraft and the engine was taken over by the lessor.

AAIB had informed the lessor that the aircraft was involved in a Serious Incident and the aircraft engine was awaiting shipping to Manufacturer's facility for undergoing strip examination and defect analysis. The lessor responded by informing AAIB that it is aware of the investigation requirement and would provide the requisite support. However, no response of any kind was received to subsequent follow-up.

1.18 Additional Information

1.18.1 Earlier Engine related occurrences in M/s Jet Airways fleet

As per the information available from M/s Jet Airways, 08 occurrences have been reported on its ATR 72 aircraft fleet earlier, involving Air Turnback, In-flight Shut Down, Engine Fire etc excluding the present case. The details are as below: -

Sr. No.	Date	Aircraft	Event and ESN
1	11.02.2010	VT-JCN	Air Turn Back, IFSD
2	16.03.2010	VT-JCN	Air Turn Back, IFSD
3	22.08.2011	VT-JCG	IFSD
4	29.03.2013	VT-JCM	IFSD
5	16.02.2014	VT-JCJ	Air Turn Back, Fire and IFSD
6	07.02.2015	VT-JCR	IFSD
7	15.06.2016	VT-JCL	Air Turn Back, Fire and IFSD
8	22.06.2018	VT-JCT	Air Turn Back, Fire and IFSD

Similar to the present incident, the incident involving VT-JCL also involved failure of Power Turbine (PT) Stage 2 blades. The said incident was investigated by AAIB. As per the report provided by the engine manufacturer, the failure of blade in that case was caused due to non-compliance of SB21876, which had been introduced as a measure to resolve issue related to failure of PT Stage 2 blades caused by sulfidation, with introduction of chromium coated blade part.

In addition to the above, another two occurrences involving PT Stage 2 blade failure were also reported in ATR-72 fleet of M/s Jet Airways earlier. Sulfidation was identified as cause of failure in one of these occurrences.

PW127F Engine ESN EB0361, installed on VT-JCN was in compliance of SB21876. SB21876 was later withdrawn by the Engine Manufacturer as durability of chromium coated blades was found less than desired. SB21917 was later introduced to restore the blades to previous uncoated blade part. VT-JCN was not in compliance of SB21917.

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 on 26.11.2018. 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. The failed engine was also complying with SB21876, which was introduced to prevent failure of PT Stage 2 blade caused by sulfidation in the blades.

2.2 Weather

The METAR issued on the date of incident indicated good weather and visibility of more than 10 Km. There was no significant change predicted in the METAR. The CVR and ATC recordings of the conversation between crew and ATC as well as cockpit conversation indicate that crew did not face any problem in sighting the runway.

2.3 Flight Recorders

The DFDR data does not indicate any significant discrepancy in both engines' parameters. The RH engine was shut at 1514 UTC. The LH engine had continued to give normal power till it was shut down by pilot after landing and parking.

3 CONCLUSION

3.1 Findings

3.1.1 Aircraft had a valid Certificate of Airworthiness and was certified and maintained in accordance with the approved maintenance schedule.

3.1.2 The flight crew was current and qualified to operate the flight.

3.1.3 M/s Jet Airways had witnessed 03 PT Stage 2 blade failure incidents prior to the present case. Failure of blades in two of these incidents was attributed to sulfidation in the blades.

- 3.1.4 SB 21876 was introduced by the manufacturer as a measure to prevent failure of PT Stage 2 blades due to sulfidation. The incident engine was in compliance of SB 21876.
- 3.1.5 SB 21917 was later introduced to undo SB 21876, due to durability issue with chromium coated blades introduced by SB 21876. Incident Engine was not in compliance of SB 21917
- 3.1.6 The aircraft was deregistered by DGCA and Lessor took over control of Aircraft and its Engines, after the airlines ran into financial trouble.
- 3.1.7 Investigation required to be carried out on the Engine to find out the cause of failure could not be carried out as the Engine went into control of Lessor, after the airline closed down.

3.2 Probable Cause of the Incident

The probable cause of failure could not be established as no information could be obtained from the Lessor in respect of Engine Dis-assembly and Failure Analysis.

4 Recommendations

- 4.1 DGCA in consultation with AAIB should ensure that procedures and regulations are put in place to establish control of an Investigator over “wreckage and components” of aircraft owned by Lessors, that are involved in accidents or incidents.
- 4.2 DGCA should apprise its officers to confirm from AAIB if any component or aircraft is required for investigation purpose before the aircraft is deregistered.



Jasbir Singh Larhga
Investigator in Charge



Dinesh Kumar
Investigator

Date: 08.04.20

Place: New Delhi