GOVERNMENT OF INDIA
MINISTRY OF CIVIL AVIATION
AIRCRAFT ACCIDENT INVESTIGATION BUREAU

FINAL INVESTIGATION REPORT OF SERIOUS INCIDENT TO M/S JET AIRWAYS LTD. ATR 72 AIRCRAFT VT-JCS AT HYDERABAD ON 07/06/2014

FOREWORD

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. 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 2012 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 incident which may help to prevent such future incidents.

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FINAL INVESTIGATION REPORT OF SERIOUS INCIDENT TO M/S JET AIRWAYS ATR 72-212A AIRCRAFT VT-JCS AT HYDERABAD ON 07/06/2014

1.	Aircraft Type	ATR 72-212A
2.	Nationality	INDIAN
3.	Registration	VT - JCS
4.	Owner	M/s Injet Leasing Company Ltd
5.	Operator	Jet Airways Ltd
6.	Pilot – in –Command	Holder of ATPL
7.	Co-Pilot	Holder of CPL
8.	Place of incident	Hyderabad
9.	Co-ordinates of incident Site	17° 14' 26" N, 78° 25' 44" E
10.	Last point of Departure	Rajahmundry
11.	Intended place of Landing	Hyderabad
12.	Date & Time of incident	07thJune, 2014, 1008 UTC
13.	Passengers on Board	62
14.	Extent of Injuries	NIL
15.	Crew on Board	04
16.	Extent of Injuries	NIL
17.	Phase of Operation	Taxing
18.	Type of Incident:	Smoke in Cockpit and Cabin

(ALL TIMINGS IN THE REPORT ARE IN UTC)

SYNOPSIS:

On 07.06.2014, M/s Jet Airways ATR 72-212 A aircraft VT-JCS while operating flight 9W-2760 (Rajahmundry to Hyderabad) was involved in a serious incident during taxiing at Hyderabad.

The aircraft had landed at Hyderabad at around 1003 UTC. During taxi, burning smell along with thick white smoke was observed in cockpit and cabin. Almost at the same time, flight crew got an electrical smoke warning in the cockpit. The cockpit crew performed corresponding emergency checklist but the smoke continued to increase both in cockpit and in cabin. As required by the procedure the flight crew carried out engine shut down. The smoke still existed for which the flight crew was unable to identify the source. The passengers were safely evacuated through normal passenger door on Taxiway B4 in coordination with ATC. There were no injuries to any of the occupants.

Ministry of Civil Aviation constituted a Committee of Inquiry to investigate into the causes of the incident under Rule 11 of the Aircraft (Investigation of Accidents and Incidents) Rules 2012 vide order no. 15018/01/2014- DG dated 20.11.2014. The investigation has been carried out with the sole objective of avoiding recurrence of such incidents.

Inadequate air supply across the bearing seal, required for prevention of oil seepage in the airflow, due P2.5/P3 air switching valve being sticky and deteriorated #4 bearing housing resulted in seepage of oil into P2.5 air system causing the oil smell& smoke in the cabin.

To avoid recurrence, it is recommended that:

- In view of the non-functioning of the Air Switching Valve which is an on condition item, the operator may carry out visual inspection of the Air Switching Valve during HSI and go for overhauling of the Air Switching Valves during the engine overhaul.
- To have better appreciation of the indications of deterioration of core engine during boroscope inspection, the line maintenance personnel may associate with the major overhaul and HSI.

1. FACTUAL INFORMATION.

1.1 History of the flight

On 7.6.2014, ATR 72 -212Aaircraft VT-JCS had operated flight from Rajahmundry to Hyderabad. The aircraft was under the command of Captain holding ATPL with co-pilot holding CPL license. There were 66 persons on board the aircraft which including 62 passengers, 02 flight crew and 02 cabin crew. The aircraft got airborne from Rajahmundry at around 0910 UTC. The weather at the time of departure from Rajahmundry, en-route and at destination was fine with visibility of more than 5000 meters.

The en-route flight was uneventful till landing at Hyderabad on runway 27. After landing at Hyderabad and when the aircraft left the active runway, CCIC noticed smoke in the cabin which was white in color associated with a smell originating from the mid cabin. As per CCIC the smell was like that of electrical wires. The cabin crew made a PA announcement for the passengers to cover their nose and mouth with a piece of cloth and breathe normally. The situation was then immediately brought to the knowledge of the flight crew who also informed that there was smoke in the cockpit as well. Cockpit crew got an electrical smoke warning in the cockpit. An AME who was travelling as ACM was called by the captain in the cockpit. The aircraft was stopped on the taxiway and captain instructed cabin crew to be at their stations.

ATC was informed about the situation. The cockpit crew performed emergency checklist (Smoke followed by Electrical Smoke Checklist) and as per the procedure the crew carried out engine shut down. Smoke still continued for which the flight crew was unable to identify the source. Immediately, captain again informed ATC that the smoke is uncontrollable and they will de-plane the passengers on Taxiway B4.

After the aircraft engines were stopped & the seat belt signs were switched off, Captain instructed cabin crew to open the aft door and de-plane the passengers without their hand baggage. The cabin crew after ensuring that the conditions outside were safe evacuated the passengers on taxiway in coordination with ATC, and ground staff. There was no injury and the passengers were taken to terminal through coaches.

Thereafter the crew completed ground emergency evacuation checklist and secured the aircraft. The permission to tow the aircraft back to bay was obtained from ATC. As smoke was still in the cockpit, cockpit crew came out of the aircraft prior to towing of the aircraft. The incident occurred in day light conditions and there was no fire.

1.2 Injuries to persons.

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	NIL
MINOR/NONE	04	62	----

1.3 Damage to Aircraft.

External visual inspection of the aircraft was carried out. There was no burning sign or any other abnormality. CB panels were opened, forward cargo compartment floor board was removed and no abnormality observed.

Both the packs were operated in auto and manual mode, one at a time for a prolonged period. Though the pack operation was found normal but oil smell was observed both in the cockpit & the cabin. No odour was observed in bleed valve controlled air supply nor was any restriction observed in the metering plugs.

Boroscopic inspection of both the engines was carried out. Dried oil stains from leading edge to 1/3rd of the chord, on all the vanes of LH engine HP impeller were observed.

In view of the above observations, the involved engine was removed for further detailed strip examination.

1.4 Other Damage:

Nil

1.5 Personnel information:

1.5.1 Pilot – in – Command:

AGE	28 years
License	ATPL
Date of Issue	02.09.2011
Valid up to	01.09.2015
Class	Single/Multi Engine Land
Endorsements as PIC	01.10.2013
Date of Med. Exam.	03.07.2013
Med. Exam valid upto	02.07.2014
FRTO License.	Valid
Date of issue	18.08.2007
Valid up to	17.09.2017
Total flying experience	4697:12hours
Experience on Type	1151:47 hours
Last flown on type	06.06.2014
Rest before duty	21:45 hours
Total flying experience during last 180 days	397:20 hours
Total flying experience during last 90 days	134:02 hours
Total flying experience during last 30 days	47:06 hours
Total flying experience during last 07 Days	13:25 hours
Total flying experience during last 24 Hours	02:25 hours

1.5.2 Co-Pilot:

AGE	30 years
License	CPL
Date of Issue	17.01.2008
Valid up to	16.01.2018
Class	Single/Multi Engine Land
Date of Med. Exam.	25.04.2014
Med. Exam valid upto	24.04.2015
FRTO License No.	Valid
Date of issue	07.12.2012
Valid up to	06.12.2017
Total flying experience	3755:37 hours
Total flying experience on type	954:15 hours
Last flown on type	06/06/2014
Rest before duty	21:45 hours
Total flying experience during last 180 days	282:13 hours
Total flying experience during last 90 days	94:09 hours
Total flying experience during last 30 days	68:11 hours
Total flying experience during last 07 Days	20:34 hours
Total flying experience during last 24 Hours	02:25 hours

1.6 Aircraft information:

The aircraft manufactured by M/s Avionics De Transport (Regional) with MSN 920, was registered with DGCA under category 'A' and the Certificate of Registration No. 4139 was issued on 29th Oct 2010.

The aircraft is certified in Normal category, for day and night operation under VFR & IFR. The maximum operating altitude is 25000 feet (7620 m) and maximum take-off weight is 22,800 Kgs. Aircraft length is 27.2 meters, wingspan is 27.0 meters with height 7.6 meters. The aircraft is a fitted with two PW127F Engines.

The Certificate of Airworthiness 6248 issued by DGCA on 29th Oct 2010 was valid on the day of incident. The Aircraft was holding a valid Aero Mobile LicenceA-006/050/WRLO-10. The Aircraft had flown 10767.10 airframe hours since new and 10767.10 airframe hours since the issue of last C of A.

Last layover schedule was done on 02.06.2014 at Chennai at 10729:10 airframe hours. Certificate of Release to Service which was issued on 07.6.2014 at Rajahmundry at 10767:10 Airframe hours was valid on the date of incident.

The aircraft and its Engines are being maintained as per the maintenance program approved by DGCA consisting of calendar period/ flying Hours based maintenance. The last Hot Section Inspection (HSI) was carried out on the involved engine in Aug 2012.

Details of involved engine (S/N AV0112)

- Engine Model: PW127F
- Time Since New : 34,509 Hrs
- Time Since O/H : 12,914 Hrs
- Time since LSV: 5754 Hrs
- Cycle Since New: 29,048
- Cycle since O/H : 10,555
- Cycle since LSV: 4986

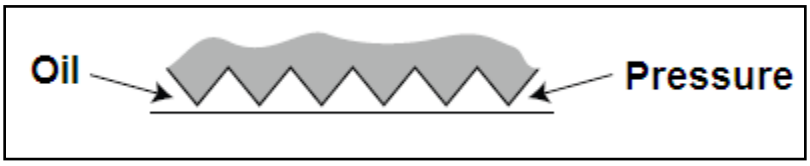
The last major inspection 'A6' Check which was carried out on the Aircraft on 23.05.2014 at 10632 TSN / 8589 CSN. Subsequently all lower inspections,

including last flight inspection and pre-flight checks, were carried out as and when due before the incident.

Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine has been complied with as on date of event. Prior to the incident flight there was no pending/repetitive defect

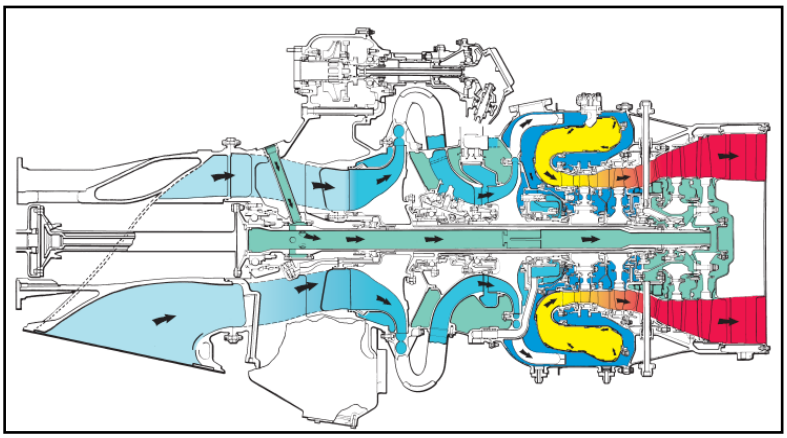
Air System

On this aircraft both low pressure and high pressure compressor discharge air is used for various purposes other than combustion which includes cabin bleed, cabin pressurisation and bearing cavity sealing. Air flow through labyrinth seals pressurizes bearing cavity seals and avoids oil seepage into the airflow. At times only air pressure is utilised and flow is not required.



LABYRINTH SEAL

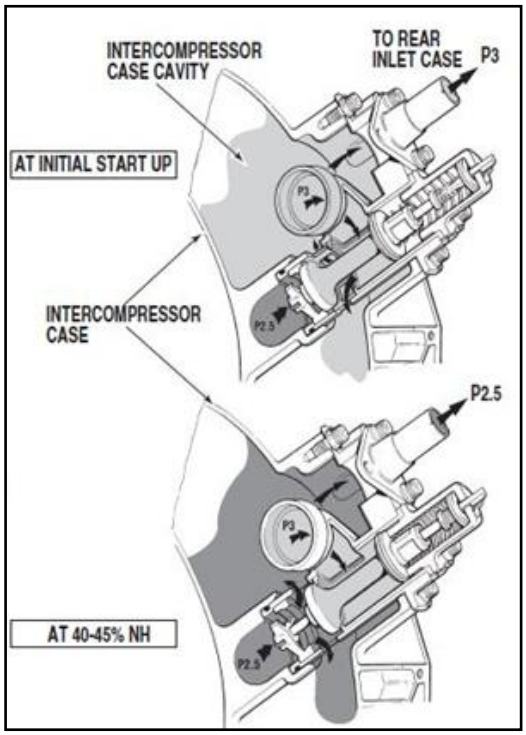
Labyrinth seal is a circumferential multi-grooved ring in a close-fitting plain. Air pressure or pressure in the area to be sealed, which is higher than oil cavity pressure, undergoes a gradual pressure drop as it travels in and out of the grooves across the seal. When sealing pressure is equal to the opposing pressure, flow in either direction is stopped.

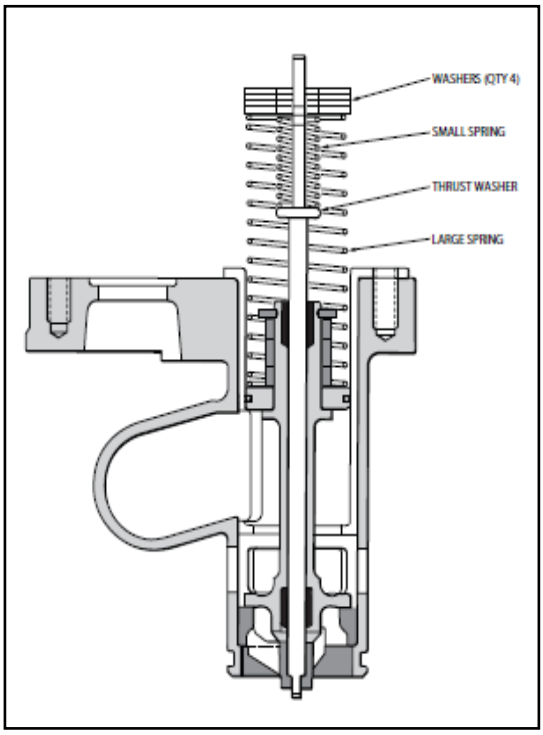


BEARING COMPARTMENT SEALING

The engine provides air bleed extraction ports from both compressors i.e. the low pressure (LP/P2.5) and the high pressure (HP/P3), as the two bleed ports are connected to the same duct. A P2.5 check valve is installed in the low pressure port to prevent back flow from the high pressure compressor (P3) to the low pressure compressor (P2.5).

The P2.5/P3 air pressure switching valve ensures an adequate air supply for bearing cavity sealing.





AIR PRESSURE SWITCHING VALVE

The switching valve is located in the intercom pressure case and provides adequate air supply during starting by directing P3 air to areas normally pressurized by P2.5 (during initial start-up, P3 is the only sufficiently pressurized air available). The valve spring holds the valve against the seat, blocking P2.5 air. P3 air enters the intercom pressure case through slots in the valve housing and exits through the adapter to the rear inlet case. P2.5 increases with increasing NH, and at 40% to 45% NH, P2.5 overcomes the spring and pushes the valve and piston up to back P3 air. P2.5 air enters the intercom pressure case and also replaces P3 air in the power turbine shaft seal housing situated in

the rear inlet case. As per the maintenance practices the four washers as shown in the figure above are to be installed at all times.

The involved P2.5/P3 Air Switching Valve was also last inspected/ overhauled along with the engine.

1.7 Meteorological information:

The following is the METAR information for Hyderabad Airport, of the date of incident.

Time(UTC)	Winds	Visibility	Clouds
0621	290/10	5 Km	FEW at 020
0703	290/10	6 Km	FEW at 020, SCT at 025
1000	310/09	6 Km	FEW at 020

1.8 Aids to navigation:

Not Applicable.

1.9 Communications:

There was always loud and clear two way communications between the ATC and the aircraft.

1.10 Aerodrome information:

There is one single runway 09/27 available at Hyderabad international airport. The ILS is available for approach for runway 27. DVOR is also available at HIAL. The ATC is controlled and manned by Airport Authority of India.

1.11 Flight Recorders:

CVR: CVR serial number 01215 was removed after the incident and was replayed. The relevant conversation was available.

DFDR: DFDR serial number 000652472was removed after the incident and readout. Smoke & electrical warning came while the aircraft was taxiing after landing. The warning lasted for 07 seconds. There was no other warning or malfunction.

1.12 Wreckage and impact information.

Nil

1.13 Medical and pathological Information:

The preflight medical was carried out prior to the flight for both the cockpit crew members including breath analyzer test and found satisfactory.

1.14 Fire:

There was no fire.

1.15 Survival aspects:

The incident was survivable.

1.16 Tests and research:

Nil

1.17 Organizational and management information:

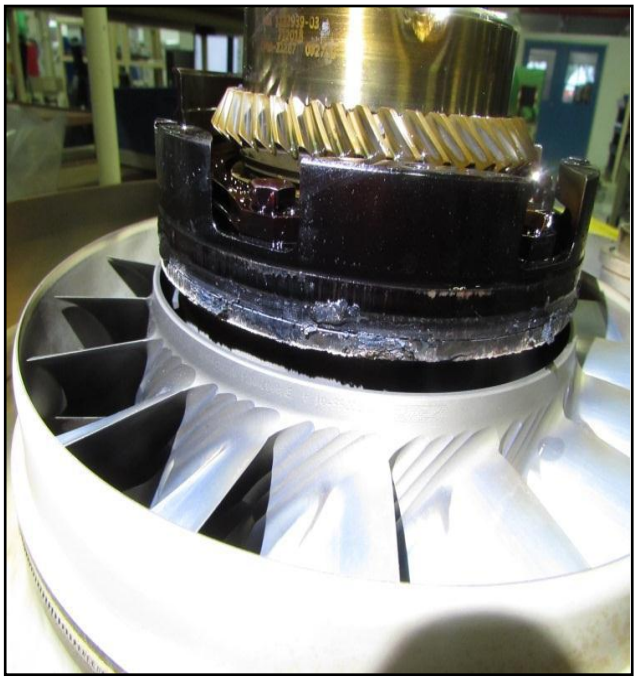
The aircraft was operated by an SOP holder holding a valid SOP with the aircraft endorsed. The maintenance of the aircraft is carried out under CAR 145 approval. Line maintenance is carried out in house and major maintenance is outsourced.

1.18 Additional information:

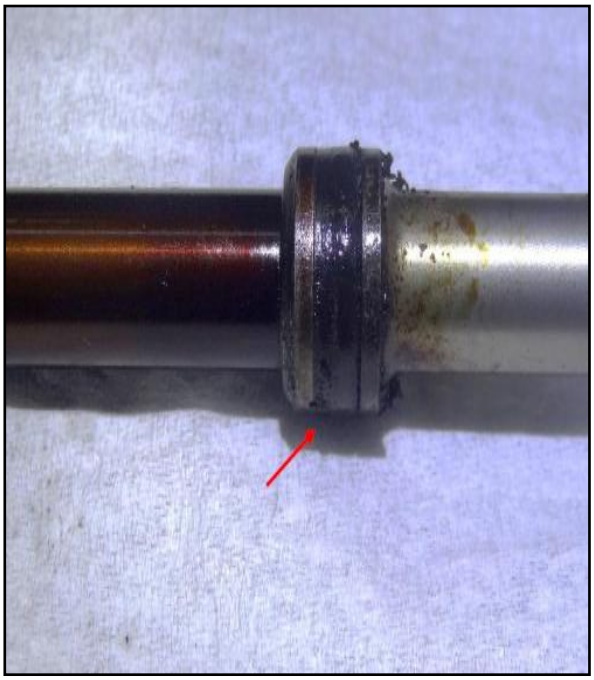
The involved engine was removed and sent to P&W (SEA) for further investigation and a report was received. The engine was tested to replicate oil leak conditions and engine oil consumption rate was found within acceptable

limits. Boroscope inspection revealed oil stain at HP impeller vanes, at 5'O clock & 6'O Clock position on Inter compressor case plenum, Gas generator case and inner front vane housing mating diameter. The engine was then strip examined and it was observed that almost the whole gas path (core engine) had oil stain marks, corrosion, fretting, rubbing etc. which were due to operational wear and tear. The engine investigation opined that these are unlikely to contribute to the oil smell in the cabin.

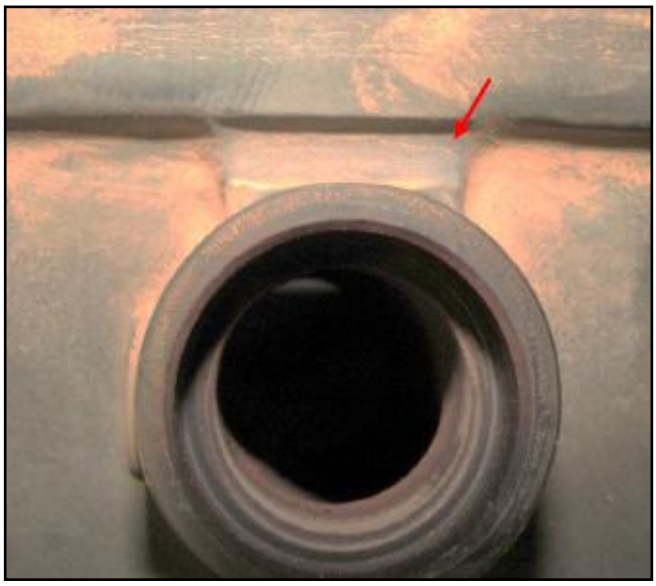
Preformed packing on LP diffuser case and ICC-GGC transfer tube packing was found flattened and hardened. Preformed packing on No. 4 bearing housing and NL sensor probe was also found deteriorated.



DETERIORATED PACKING OF NO. 4 BEARING HOUSING



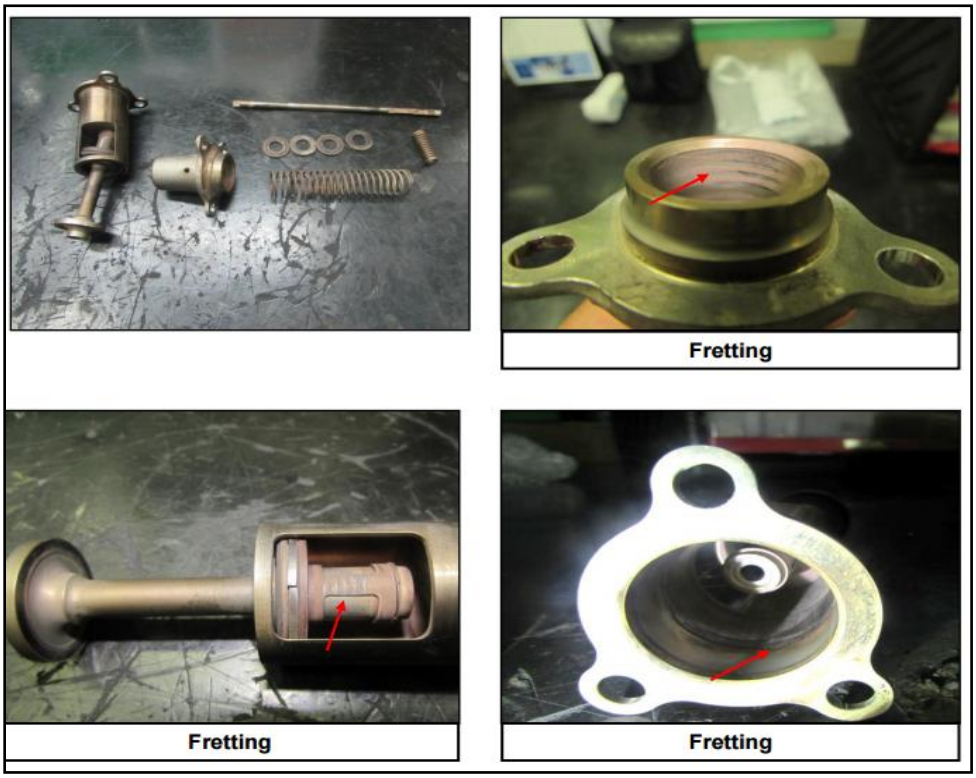
FLATTENED AND HARDENED PACKING OF NL SENSOR PROBE



ICC TRANSFER TUBE

HPIMPELLER HOUSING

The four spacers were found installed in P2.5/P3 air switching valve, but the valve was found sticky during functional check. Fretting was observed on its cover, guide pin, inner housing and sleeve.



P 2.5/3 AIR SWITCHING VALVE

As per the engine investigation report the oil stain on the ICC plenum is attributed to deteriorated preformed packing on No.4 bearing housing and flattened/ hardened preformed packing of NL sensor probe and inter compressor case transfer tubes. The engine sent for normal HSI or overhaul also exhibit similar findings of erosion, corrosion, fretting, Rubbing, oxidation etc. These findings are due to engine in-sevice condition and are only accessible when the Engine striped open at shop.

During the gas path Borescope inspection damages like cracks, burn through holes, coating loss, nicks, dents are usually observed. These damages are covered in MM with limits specific to damages are provided. Based on the damage under limits the engine is further inspected under the reduced Borescope interval if required.

The reported oil smell in cabin and oil leak on HP impeller area was confirmed during disassembly and evidence of coked oil stain was observed on the HP impeller vane. Based on the hardware observations, the oil smell in cabin is attributed to the combination of P2.5/ P3 air switching valve (p/n: 3114892-01) being sticky, causing inadequate air supply across the bearing seal and deteriorated no.4 bearing housing (p/n: 3121731-01) that resulted oil seepage, which contaminated the P2.5 air system causing the reported oil smell into cabin.

It was informed that there were three unscheduled removal in the airline ATR fleet since its operations.

1.19 Useful or effective investigation techniques:

Nil

2. ANALYSIS

2.1 Weather:

The weather at the airport of departure, en-route and at the airport of arrival was fine and is not a contributory factor to the incident.

2.2 Pilot Handling of the aircraft:

The aircraft had completed the flight and landed at destination uneventfully. It was during taxiing that burning smell along with thick white smoke was observed in cockpit and cabin. Cockpit crew got an electrical smoke warning in the cockpit. The cockpit crew stopped the aircraft at taxiway and informed the same to ATC. Emergency checklist (Electrical Smoke Checklist) was performed prior to engine shut down as required by the emergency procedures. The smoke had continued therefore the passengers were deplaned on taxiway itself after ensuring the external safe conditions. The crew had performed all actions as per ground emergency evacuation checklist and secured the aircraft.

The cockpit crew as well as the cabin crew followed the standard procedures including that for evacuation during the incident. Hence, pilot handling of the aircraft prior to or during emergency situation is not a contributory factor to the incident.

2.3 Aircraft:

2.3.1 General

The aircraft was fully serviceable with Valid Certificate of Airworthiness at the time of incident. The Aircraft held valid Certificate of Release to Service which was issued at the airport of departure. The Aircraft was holding a valid Aero Mobile Licence. Prior to the incident flight there was no pending/repetitive defect which could have contributed to the incident.

Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications has been complied with. Transit inspections are carried out as per approved transit inspection schedules and all the higher inspection schedules include

checks/inspection as per the manufacturer's guidelines as specified in Maintenance Program and approved by the Quality Manager.

The engine has operated around 5000 hours since last HSI and more than 10,000 hours since last overhaul. The core engine is not opened in routine maintenance and is stripped during these two inspections. In view of the above, it is opined that the aircraft and engine were being maintained as per the requirements and maintenance aspect is not contributory to the incident

2.3.2 Circumstances leading to the Incident

The reported oil smell in cabin and oil leak on HP impeller area was confirmed during strip investigation. It was observed that almost the whole gas path (core engine) had oil stain marks, corrosion, fretting, rubbing etc. which were due to operational wear and tear. These are unlikely to contribute to the oil smell in the cabin.

The hardware of the involved pressure switching valve (which ensures an adequate air supply for bearing cavity sealing) including the four spacers was found installed in P2.5/P3 air switching valve, but the valve was found sticky during functional check. Fretting was observed on its cover, guide pin, inner housing and sleeve.

The reason of stickiness most probably is the service wear and tear. It has failed to provide adequate air supply (P3) during taxiing after landing at destination. This inadequate pressure across the bearing seal and the damaged packaging of #4 bearing housing in combination resulted in oil seepage into the air flow and contaminated P2.5 air was fed to the cabin.

3. CONCLUSIONS:

3.1 Findings:

1. The Certificate of Registration and the Certificate of Airworthiness of the aircraft was valid on the date of incident.
2. The certificate of flight release was valid on the day of incident.

3. Both the pilots were appropriately licensed and qualified to operate the flight.
4. The maintenance of the aircraft was being done as per the approved maintenance programme.
5. All the applicable Airworthiness Directives, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine were found complied with.
6. The weather has not contributed to the incident in any manner.
7. While taxing to the bay, thick white smoke and smell was observed by cabin crew in the cabin.
8. At the same time electrical warning came on in the cockpit, which lasted for 07 seconds. The flight crew also observed smoke in the cockpit.
9. The flight crew was not able to figure out the source of smoke generation and the engine was shut down as per the procedures.
10. After the aircraft engines were stopped, the cabin crew after ensuring the safe conditions outside the aircraft, deplaned the passengers without hand baggage.
11. The pack operation on ground was found normal but oil smell was observed in cockpit & cabin.
12. There was no odour in bleed valve controlled air supply nor was any restriction observed in the metering plugs.
13. Boroscopic inspection of both the engines revealed dried oil stains from leading edge to 1/3rd of the chord on all the vanes of LH engine HP impeller.
14. The whole gas path (core engine), during strip examination exhibited oil stain marks, corrosion, fretting, rubbing etc. which were due to operational wear and tear, though these are unlikely to contribute to the oil smell in the cabin.
15. The hardware of the pressure switching valve involved including the four spacers were found installed in P2.5/P3 air switching valve. This valve which ensures an adequate air supply for bearing cavity sealing was

found sticky and in combination with damaged packing of #4 bearing housing permitted oil seepage in to the airflow.

3.2 Probable cause of the incident:

Inadequate air supply across the bearing seal, required for prevention of oil seepage in the airflow, due P2.5/P3 air switching valve being sticky and deteriorated #4 bearing housing resulted in seepage of oil into P2.5 air system causing the oil smell & smoke in the cabin.

4 SAFETY RECOMMENDATIONS:

- In view of the non-functioning of the Air Switching Valve which is an on condition item, the operator may carry out visual inspection of the Air Switching Valve during HSI and go for overhauling of the Air Switching Valves during the engine overhaul.
- To have better appreciation of the indications of deterioration of core engine during boroscope inspection, the line maintenance personnel may associate with the major overhaul and HSI.

Shilpy Satiya 5/8/16
(Shilpy Satiya)
Member
Committee of Inquiry

Passi 5/8/2016
(R.S. Passi)
Chairman
Committee of Inquiry

Date : 05th Aug 2016
Place: New Delhi