GOVERNMENT OF INDIA

FINAL INVESTIGATION REPORT OF SERIOUS INCIDENT TO M/S JET AIRWAYS LTD. ATR 72 AIRCRAFT VT-JCZ AT DELHI ON 14/08/2014

AIRCRAFT ACCIDENT INVESTIGATION BUREAU
MINISTRY OF CIVIL AVIATION
NEW DELHI

FOREWORD

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and 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 LTD. ATR 72-500 AIRCRAFT VT-JCZ AT NEW DELHI ON 14/08/2014

1. Aircraft Type	: ATR 72-500
Nationality	: INDIAN
Registration	: VT - JCZ
2. Owner/ Operator	: M/S Celestail Aviation Trading 71 Ltd/ Jet Airways Ltd
3. Pilot – in –Command	: ATPL holder on type
Extent of injuries	: Nil
4. Co-Pilot	: ATPL holder on type
Extent of injuries	: Nil
5. Place of incident	: New Delhi
6. Co-ordinates of incident Site	: 28.5686° N, 77.1122° E
7. Last point of Departure	: New Delhi
8. Intended place of Landing	: Bhopal
9. Date & Time of incident	: 14th Aug, 2014 0100 UTC (Approx.)
10. Passengers on Board	: 65
Extent of Injuries	: NIL
11. Phase of Operation	: Takeoff
12. Type of incident	: Rejected takeoff due engine fire

(ALL TIMINGS IN THE REPORT ARE IN UTC)

SYNOPSIS:

Jet Airways Ltd. ATR 72 -500 aircraft VT-JCZ while operating flight 9W-2654 (New Delhi to Bhopal) was involved in a serious incident on 14.08.2015 at New Delhi.

During initial takeoff roll although the parameters were normal but soon after engine fire warning illuminated. Takeoff was rejected before V1 and all the actions by the flight crew “on ground engine fire or Severe Mechanical Damage” checklist was carried out. MAY DAY call was given to ATC with a request to activate all the emergency services. Fire extinguishing agent was discharged as per the checklist. The fire warning was extinguished after the second extinguisher was discharged. Subsequently aircraft was towed back to bay and passengers were disembarked safely. There were no injuries to any of the occupant

Ministry of Civil Aviation declared the occurrence as Serious Incident and constituted a Committee of Inquiry to investigate into the causes of the serious incident under Rule 11 of Aircraft (Investigation of Accidents and Incidents) Rules 2012 vide notification no. 15018/01/2014- DG.

1. FACTUAL INFORMATION.

1.1 History of the flight

Jet Airways Ltd. ATR 72 -500 aircraft VT-JCZ while operating flight 9W-2654 (New Delhi to Bhopal) was involved in a serious incident on 14.08.2014 at New Delhi. The aircraft was under the command of an ATPL holder with co-pilot also holding an ATPL license.

On 13.08.2014, prior to the incident, a scheduled fuel nozzle replacement was carried out on engine no.01 during night halt at Delhi. After replacement of fuel nozzle, wet motoring was carried out and no leak was observed. Idle power engine ground run was carried out and slight wetting at #6 fuel nozzle was observed, #6 fuel nozzle was torqued, again ground run was carried out and no leak was observed. The task was completed at 2350 UTC. Schedule was also signed for the above task. Subsequently aircraft was released for flight, which was scheduled at 0050 hrs UTC on 14.08.2014.

The weather at the time o

f departure from New Delhi was fine with visibility 5000 m. The aircraft was cleared for takeoff from runway 29 by ATC at around 0050 UTC. During initial takeoff roll all the parameters were normal. First officer was the Pilot Flying and commander was the Pilot monitoring. Soon after initial takeoff roll, engine 01 fire warning illuminated (before V1) with the engine 01 fire alarm getting activated. Pilot immediately took controls from First officer and Takeoff was rejected. All the actions as per "on ground engine fire or Severe Mechanical Damage" checklist was carried out. MAY DAY call was given to ATC with a request to activate all the emergency services. Cabin crew were also informed about the reject takeoff. Fire extinguishing agent was discharged as per the checklist. The fire warning was extinguished after the second extinguisher was discharged. Subsequently aircraft was towed back to bay and passengers were disembarked safely. There were no injuries to any of the occupant

1.2 Injuries to persons.

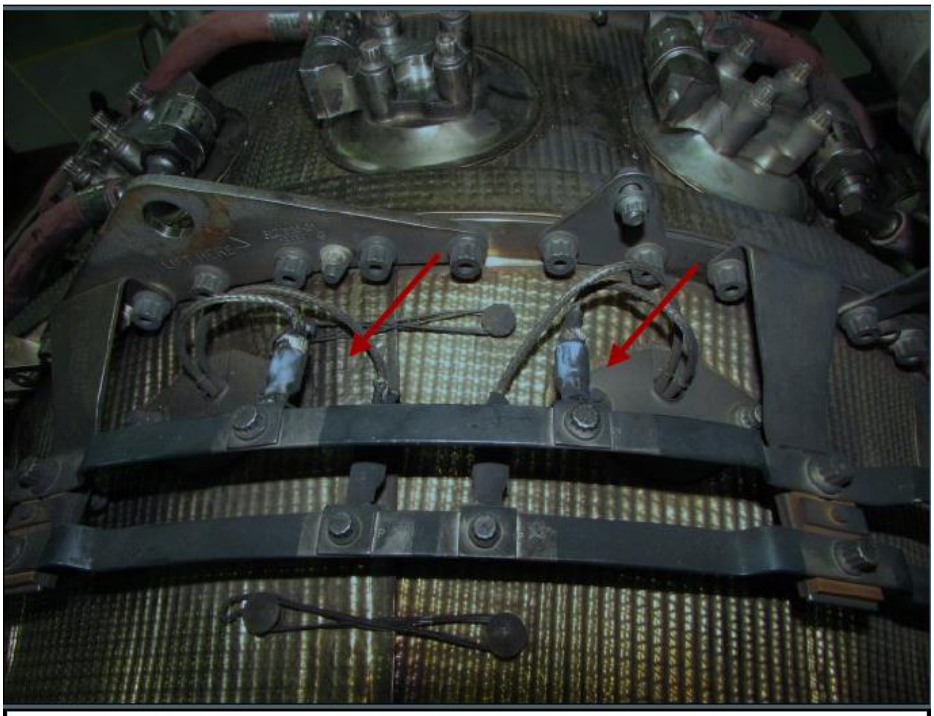
INJURIES	**CREW**	**PASSENGERS**	**OTHERS**
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
MINOR	Nil	Nil	----

1.3 Damage to Aircraft.

There was no damage observed to the aircraft structure. Damage was limited to the aircraft engine no 01.

1. Evidence of heat damage and fire was observed on the right hand (RH) rearward of the engine after the fuel nozzles.
2. Soot deposit observed aft of the fuel nozzles, from the #1 fuel nozzle position to the #7 fuel nozzle position.
3. #1 to #4 fuel nozzles and manifold observed with soot deposit
4. T6 system observed with heat damage corresponding to fuel nozzle position #1 to #7

5. #1, 2 and 3 fuel nozzle position on the secondary fuel manifold observed conical seals with signs of scoring.
6. #4 fuel nozzle position observed conical seal on secondary manifold with signs of deformation on the conical surface as well as on the legs.
7. #5 fuel nozzle position observed conical seal on secondary manifold with signs of scoring.



Heat damage

1.4 Other damage:

Nil

1.5 Personnel information:

1.5.1 Pilot – in – Command:

AGE	: 44 years
Licence	: ATPL
Date of Initial Issue	: 20.02.2003
Valid up to	: 19.02.2015
Category	: Aeroplane
Class	: Multi Engine Land/Sea

Endorsements as PIC	:	C152A, PA23, SUPER KING AIR B- 200, ATR 72 500/600
Date of Med. Exam.	:	09.04.2014
Med. Exam valid upto	:	08.04.2015
FRTO Licence No.	:	License Valid
Total flying experience	:	8708:47 hours (Approx)
Experience as PIC on type	:	4457:11 hours (Approx)
Last flown on type	:	12.08.2014
Total flying experience during		
last 180 days	:	305:46 Hrs. (Approx)
last 90 days	:	203:04 Hrs. (Approx)
last 30 days	:	57:37 Hrs. (Approx)
last 07 Days	:	09:05 Hrs. (Approx)
last 24 Hours	:	05:40 Hrs. (Approx)

1.5.2 Co-Pilot:

AGE	:	30 years
License	:	ATPL
Date of Issue	:	27.02.2014
Valid up to	:	26.02.2016
Category	:	Aeroplane
Class	:	Multi Engine Land
Endorsements as F/O	:	ATR 72-500/600
Date of Med. Exam.	:	29.11.2013
Med. Exam valid upto	:	28.11.2014
FRTO License No.	:	License Valid
Total flying experience	:	2394:19 hours (Approx.)
Last flown on type	:	13.08.2014
Total flying experience during		
Last 180 days	:	237:34 Hrs. (Approx)
Last 90 days	:	162:09 Hrs. (Approx)
Last 30 days	:	44:39 Hrs. (Approx)
Last 07 Days	:	10:40 Hrs. (Approx)
Last 24 Hours	:	05:40 Hrs. (Approx)

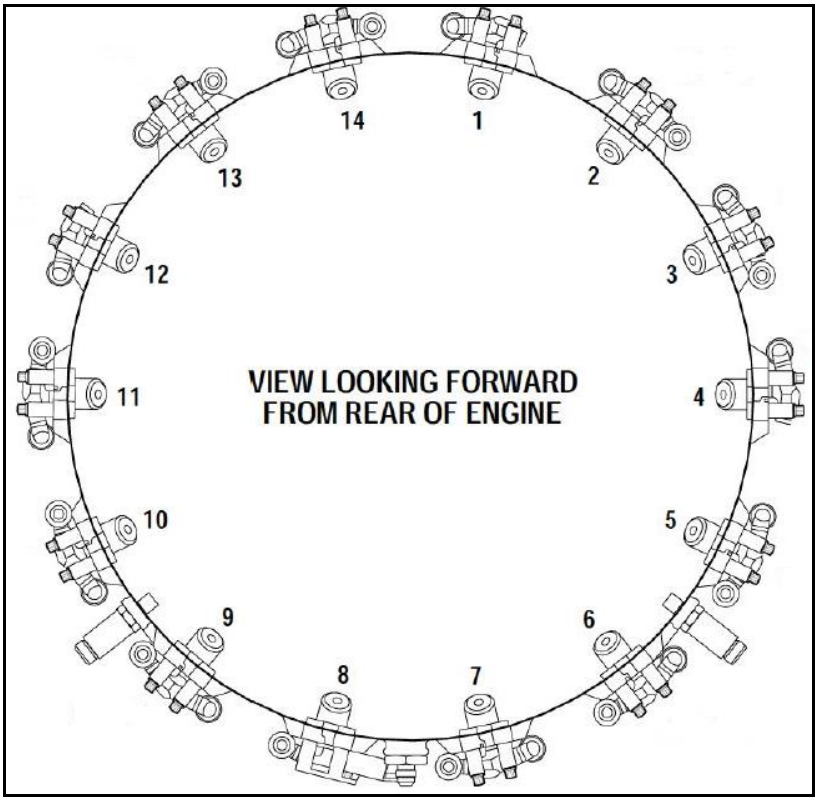
1.6 Aircraft information:

Fuel Supply

The engine fuel supply system consist of the fuel supply line, the fuel pump, the fuel heater/ filter assembly, fuel control unit, the fuel flow transmitter, the FCOC, the fuel divider and fuel nozzles.

The fuel supply line is connected to the flexible hose located between the firewall and the engine connection. It is routed in the upper part of engine compartment and supplies the filter/heater assembly. The fuel then flows through the HP pump and fuel control unit (FCU) which meters the quantity of fuel necessary to the fuel nozzles. This fuel will pass through the fuel flow transmitter and FCOC.

The flow divider is mounted on the fuel inlet manifold adapter located at the 6 o’clock position on the core case. The flow divider schedules the metered fuel, from the FCU, between the primary and secondary fuel manifolds as a function of primary manifold pressure. At the engine start, the metered fuel is delivered initially by the primary nozzles, and the secondary nozzles are set in operation above the preset value.



ATR 72-500 is a Twin engine aircraft fitted with PW127F/M Engine. The aircraft is certified in Normal category, for day and night operation under VFR & IFR.

The subject aircraft was manufactured by M/s Avionis De Transport (Regional) on 07th March 2013. The aircraft was registered with DGCA under the ownership of M/S Celestial Aviation Trading 71 Ltd. The aircraft is registered under category 'A' and the Certificate of Registration No. 4411 on 11th Dec 2013.

The Certificate of Airworthiness Number 6520 under "Normal category" sub-division passenger was issued by DGCA on 11.12.2013. At the time of incident the Certificate of Airworthiness was current and was valid up to 03.11.2018. On the day of incident, the Aircraft had done airframe 2109.03 hrs since new and 2109.03 Hrs since the issuance of last C of A. The engine had logged 2109.03 hrs since new.

The ATR 72-500 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.

Accordingly, the last major inspection 'A2' Check which was carried out on the Aircraft on 10.08.2014 at 2084 TSN / 1679 CSN. Subsequently all lower inspections, after 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 entered on the Commander Defect Report/Technical Logbook of the aircraft. The certificate of Flight Release was valid prior to the incident flight.

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 are approved by the Quality Manager.

1.7 Meteorological information:

The following is the Met report for IGI Airport, New Delhi on the date of incident

Time	0500 IST
Wind	08 kts
Speed	250
Visibility	5000 meter
Clouds	FEW 040
	SCT100

1.8 Aids to navigation:

IGI international airport, New Delhi has got three runways which has the orientation 09/27, 10/28, 11/29. The VOR/DME approaches, ILS landing facility and PAPI are available on either side of all the three runways. All the Landing aids were functional at the time of incident.

1.9 Communications:

There was always two ways communication between the ATC and the aircraft.

1.10 Aerodrome information:

VIDP- Delhi International

Co-ordinates
ARP : N 28° 34' 07"
E 077° 06' 44"
Elevation : 778’ Ft.

1.11 Flight recorders:

CVR:

Readout of the CVR installed on the aircraft with part no. S200-0012-00, and Sl. No. 000129216, was carried out and following observations were made.

1. The aircraft lined up for runway 29 and flight crew carried out before takeoff checklist.
2. First officer was the Pilot Flying and commander was the Pilot monitoring. The PIC asked the Co-pilot if he has controls. Co-pilot replied in affirmative that he has controls.
3. Engine no. 01 fire warning was illuminated and PIC advised copilot to reject the take-off. MAYDAY was declared and same was intimated to ATC.
4. On ground engine fire Checklist was carried out.
5. The Co-pilot asked the commander whether emergency evacuation is required. Pilot replied in negative.
6. ATC was asked to intimate Jet Airways about the incident and to provide the tow assistance.

DFDR: The DFDR parameters were scrutinized and the information was used for investigation.

1.12 Wreckage and impact information.

Nil

1.13 Medical and pathological Information:

The preflight medical was carried out for the crew members prior to the flight along with BA test and was negative.

1.14 Fire:

Fire was limited to aircraft on engine no. 01.

1.15 Survival aspects:

The incident was survivable.

1.16 Tests and research:

NIL

1.17 Organizational and management information:

At the time of incident, M/s Jet Airways was operating a fleet of 102 aircraft, which includes 10 Boeing 777-300 ER aircraft, 12 Airbus A330-200 aircraft, 60 next generation Boeing 737-700/800/900 aircraft and 20 modern ATR 72-500 turboprop aircraft.

1.18 Additional information:

1.18.1 Procedure for Installation of fuel nozzle

The procedure as per the DGCA approved schedule for nozzle installation is as follows

After lubricating primary and secondary hose connectors threads, fuel nozzle elbow threads and locking fingers using a minimal amount of engine oil, install the primary and secondary hose connectors. While doing this one should ensure that fuel manifold hose fitting is completely seated before the final torque. Apply final torque to the flex manifold / fuel nozzle adapter connections. After installing flow divider and dump valve, carry out a leak check of flow divider, dump valve, fuel manifold and fuel adapters by wet motoring of engine. Check visually for fuel and oil leak. If required rectify

leaking components and repeat wet motoring run. Thereafter, carry out dry motoring of engine. Ground run of the engine should be carried out at 80% torque. Check visually for the leak, rectify leaking components and repeat the test.

The above procedure was followed during nozzle installation on 13.08.2014.

1.18.2 Engine Inspection

On-wing preliminary external examination of the involved engine was carried out and leakage was observed at the #1 fuel nozzle position. To duplicate on-wing initial findings, #1 nozzle fuel manifold nut was un-torque to align marker ink marks as marked out on wing. Nitrogen leak check was then carried out observed #1 nozzle with sign of leaking. Torque check was performed on all fuel nozzles B-Nuts **--** observed #2, 4 and 5 to be under torqued with #2 nozzle observed to be loose on the secondary fuel manifold. All fuel nozzles B-Nuts were re-torqued to 260 lb.in and another nitrogen leak check was performed. During second nitrogen leak check leak from #2 and #4 nozzles B-Nut was observed.

As per the P&W report, the fire occurred on the engine external only. The cause of fire may be attributed to under-torque of fuel nozzles on the right hand side of the engine.

- Evidence of heat damage and fire was observed on the right hand (RH) rearward of the engine after the fuel nozzles.

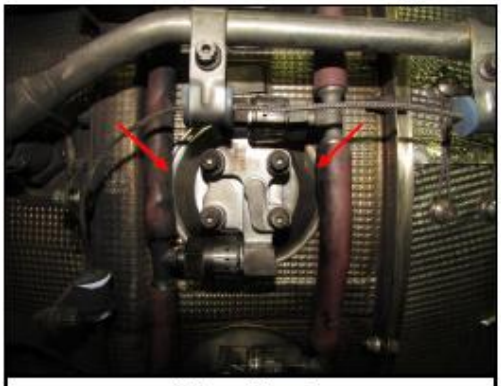
RH Rearward

- Soot deposit observed aft of the fuel nozzles, from the #1 fuel nozzle position to the #7 fuel nozzle position. Fuel flow Divider observed to be intact.

- #1 to #4 fuel nozzles and manifold observed with soot deposit.

#1 Fuel Nozzle

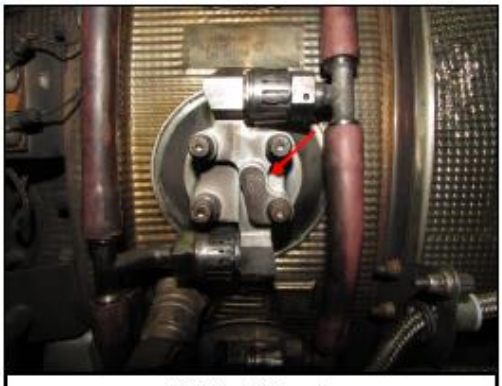
#2 Fuel Nozzle



#3 Fuel Nozzle

#4 Fuel Nozzle

- #5 to #7 fuel nozzles and manifold observed with soot deposit.



#5 Fuel Nozzle

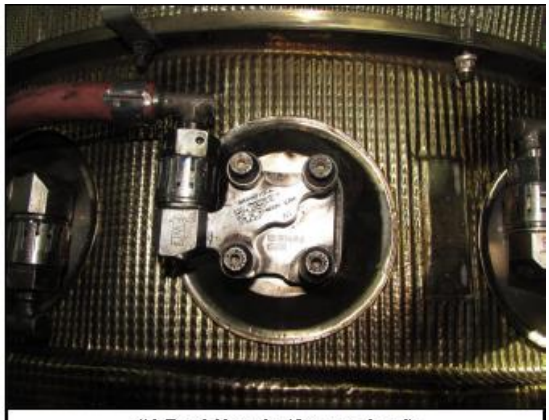
#6 Fuel Nozzle

#7 Fuel Nozzle

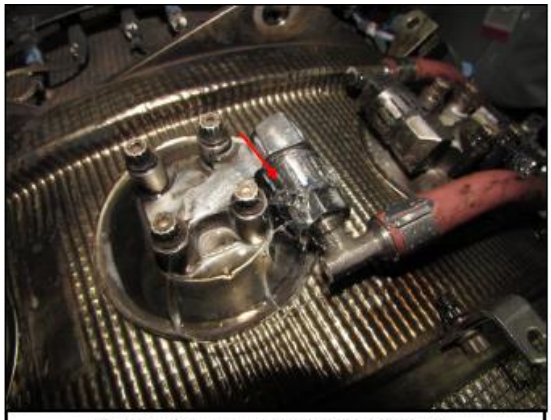
Flow Divider

- #1 fuel nozzle observed with nil sign of leak in as-received condition.

- #1 fuel nozzle observed with sign of leakage after marker ink (marked out on- wing) was aligned.

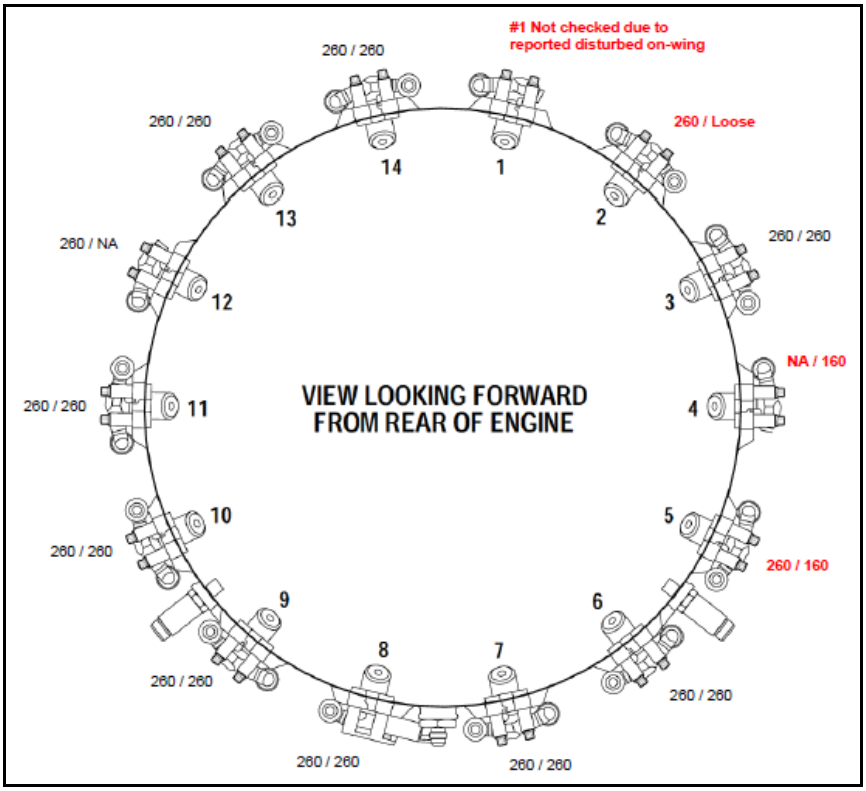


#1 Fuel Nozzle (As-received)



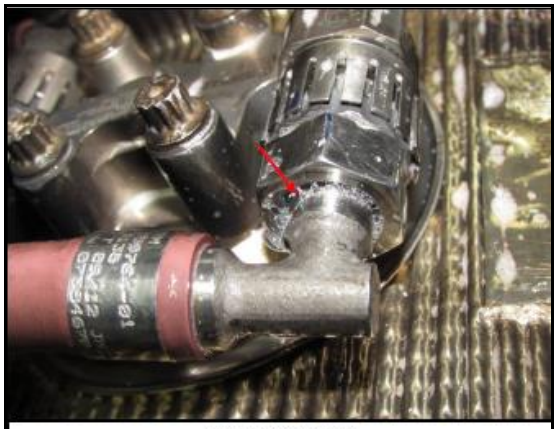
#1 Fuel Nozzle (Marker ink aligned)

- Torque check carried out on all primary and secondary fuel manifolds observed undertorque on secondary manifold at #4 and #5 position.
- #2 nozzle manifold connection observed to be loose.

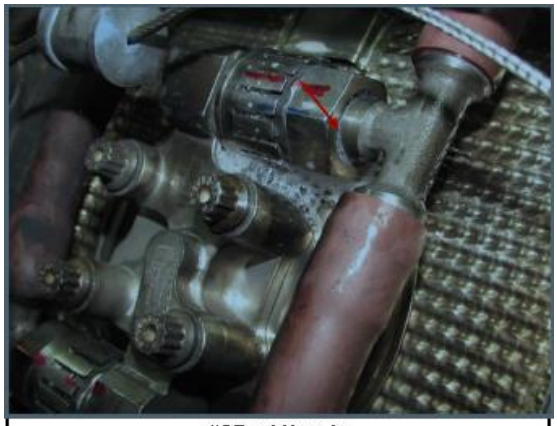


Primary/Secondary
All units are in lb.in

- Post re-torque of fuel nozzle manifold nuts to 260 lb.in observed signs of leakage at #2 and # 3 position on the secondary fuel manifold interface.



#2 Fuel Nozzle



#3Fuel Nozzle

- #4 fuel nozzle position observed conical seal on secondary manifold with signs of deformation on the conical surface as well as on the legs.
- #5 fuel nozzle position observed conical seal on secondary manifold with signs of scoring.
- #1 to 5 fuel nozzles were inspected for signs of anti-seize observed threads to be dry and shiny.
- #1 to 5 fuel nozzles were installed with new conical seals on the secondary manifold and nitrogen leak check carried out observed zero sign of leakage.
- #13 and #14 fuel nozzle manifolds disconnected at the secondary side observed threads to be dry with grey deposit indicate possible use of anti-seize at last installation.

1.19 Useful or effective investigation techniques: NIL

2. ANALYSIS

2.1 General:

Both the operating crew were appropriately licensed and qualified to operate the flight. The aircraft was having a Valid Certificate of Airworthiness at the time of incident. The Aircraft held valid Certificate of Release to Service which was issued at the airport prior to departure. The Aircraft was holding a valid Aero Mobile License. Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications has been complied with. Transit inspections were 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 weather at the airport at the time of incident was fine and is not a contributory factor to the incident.

2.2 Schedule Inspection prior to the subject flight

As per the schedule, while installing the fuel nozzles, one should ensure that fuel manifold hose fitting is completely seated and appropriate final torque is applied to the flex manifold / fuel nozzle adapter connections. After installing flow divider and dump valve, leak check should be carried out of flow divider, dump valve, fuel manifold and fuel adapters by wet motoring of engine. If required leaking components be rectified and wet motoring be repeated.

The above procedure was followed during nozzle installation on 13.08.2014. After replacement of fuel nozzle, wet motoring was carried out and no leak was observed. Idle power engine ground run was carried out and slight wetting at #6 fuel nozzle was observed, #6 fuel nozzle was torqued, again ground run was carried out and no leak was observed. As per the entries in the schedule, the actions were taken according to the given procedure. Thereafter the aircraft was released for service.

2.3 Investigation on engine for fuel leak

- On engine in as received condition, soot was observed on right hand side (from #1 to #6 fuel nozzle position) of the engine aft of the fuel nozzles.
- Nitrogen leak check carried out in as-received condition observed fuel nozzle with signs of leaking at position #2, 4 and 5 at the secondary fuel manifold interface.
- To duplicate on-wing initial findings, #1 nozzle fuel manifold nut was un-torqued to align marker ink marks as marked out on wing. Nitrogen leak check was then carried out **--** observed #1 nozzle with sign of leaking.
- Torque check was performed on all fuel nozzles between # 2, 4 and 5 (to be undertorqued) with #2 nozzle observed to be loose on the secondary fuel manifold.
- All fuel nozzles were re-torqued to 260lb.in and another nitrogen leak check was performed.
- On second nitrogen leak check, leak from #2 and 4 nozzle B-Nut was observed.
- Secondary fuel manifold was then disconnected at nozzle position #1, 2, 3, 4 and 5 to inspect for presence of conical seal, which were present at all 5 nozzles.
- #4 nozzle was observed with the 2 legs of the seal bent inwards into groove on the fuel nozzle interface area. Visible deformation is also observed on the conical sealing surface.
- Light scoring is visible on the conical surface of all five conical seals.
- Fuel manifold and fuel nozzle threads of #1, 2, 3, 4 & 5 are also observed to be dry with no sign of anti-seize compound being applied.
- New conical seals were installed at fuel nozzle position #1, 2, 3, 4 & 5.
- Nitrogen leak check carried out observed zero sign of leakage.
- Secondary fuel manifold was disconnected at #13 and #14 fuel nozzles to inspect for sign of anti-seize previously applied.
- Exposed threads observed to be dry, with a slight grey colour. Indicating likely use of anti-seize at previous installation of manifold.
- Full gas path boroscope inspection observed nil abnormality.

2.4 Preventive action taken to avoid recurrence.

The airline in order to avoid the recurrence of such incidents in the future has issued instructions in the form of circular which emphasis on the safety steps to be ensured while carrying out replacement of nozzle. In this quality circular i.e. “ATR Fuel Nozzle Installation- Leak Checks and Best Practices” it is highlighted that Fuel Nozzle change is a critical task and should be carried with due attentiveness to all the steps given in the latest task card. Salient steps emphasized are

- Before engine wet motoring check, perform Nitrogen leak test to detect leaks from B-Nuts of fuel nozzles, flow Divider, Dump Valve and fuel manifold. Failure to do so may result in leaks going unnoticed.
- Use leak check fluid to aid in the detection of leaks from the connections.
- Perform engine ground run at 80% torque, minimum for 2 minutes.
- It is mandatory to carry out duplicate inspection for the following
    - Final torque of the B-nuts of the flexible manifold with the fuel nozzle adaptor connections.
    - Nitrogen Leak test.

In addition the occurrence and the preventive actions have also been put on the e-learning portal of the operator for the information and learning of the concerned personnel.

2.5 Circumstances Leading to the incident:

The incident has occurred on 14.08.2014. On the previous night i.e. 13.08.2014 and early morning hours of 14.08.2014 the fuel nozzles were replaced as per the schedule requirements. From the records it has been observed that the task was closed at around 0520 hrs IST. As per the filled in schedule, the leak test after the installation was carried out at idle power for two minutes and aircraft released for service.

During initial takeoff roll, engine fire warning for engine #1 came on along with the fire alarm. The fire warning had come due to fuel leak from

some of the secondary nozzles. On investigation, it was found that fuel nozzles #2, 4 and 5 were under torqued.

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. On 13.08.2014, prior to the incident, a scheduled fuel nozzle replacement was carried out on engine no.01 during night halt at Delhi.
8. After replacement of fuel nozzle, wet motoring was carried out and no leak was observed.
9. Idle power engine ground run was carried out and slight wetting at #6 fuel nozzle was observed. #6 fuel nozzle was torqued, again ground run was carried out and no leak was observed. Subsequently aircraft was released for flight.
10. The aircraft was cleared for takeoff from runway 29 by ATC at around 0050 UTC.
11. First officer was the Pilot Flying and commander was the Pilot monitoring.
12. After initial takeoff roll, engine 01 fire warning illuminated (before V1) and engine 01 fire alarm got activated.
13. Pilot took over the controls from First officer and Takeoff was rejected.

14. All the required checklists were carried out and MAY DAY call was given to ATC to activate all the emergency services.
15. Both fire extinguishing agents were discharged as per the checklist.
16. The fire warning was extinguished after the second extinguisher was discharged.
17. Subsequently aircraft was towed back to bay and passengers were disembarked safely. There were no injuries to any of the occupant

3.2 Probable cause of the Incident:

The fire warning during takeoff roll was because of fire to the fuel which leaked from fuel nozzles due to loose B-nuts of fuel nozzles.

4. SAFETY RECOMMENDATIONS:

Nil in view of the actions already taken by the operator.

(Shilpy Satiya)
Member
Committee of Inquiry

(R S Passi)
Chairman
Committee of Inquiry

Date: 25/01/2017
Place: New Delhi