सत्यमेव जयते

Government of India

REPORT ON INCIDENT OF SMOKE IN THE COCKPIT TO AIR INDIA B787 AIRCRAFT VT-ANE OPERATING FLIGHT AI-380 ON 16.07.2018

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CONTENTS		
Sl. No.	Subject	Page
	Synopsis	2
1	**FACTUAL INFORMATION**	
1.1	History of flight	2
1.2	Injuries to persons	3
1.3	Damage to Aircraft	3
1.4	Other damage	4
1.5	Personnel information	4
1.6	Aircraft information	6
1.7	Meteorological information	9
1.8	Aids to navigation	9
1.9	Communications	9
1.10	Aerodrome Information	9
1.11	Flight Recorders	10
1.12	Wreckage and impact information	10
1.13	Medical and pathological Information	10
1.14	Fire	10
1.15	Survival aspects	10
1.16	Tests and research	10
1.17	Organizational and management information	10
1.18	Additional information	11
1.19	Useful or effective investigation techniques	11
2	**ANALYSIS**	
2.1	Maintenance aspect	11
2.3	Operational aspect	13
3	**CONCLUSIONS**	
3.1	Findings	13
3.2	Probable Causes and Contributing Factors	15
4	**SAFETY RECOMMENDATIONS**	15

REPORT ON INCIDENT OF SMOKE IN THE COCKPIT TO AIR INDIA B787 AIRCRAFT VT-ANE OPERATING FLIGHT AI-380 ON 16.07.2018

1.	Aircraft Type	:	Boeing 787-8
	Nationality	:	Indian
	Registration	:	VT-ANE
2.	Owner	:	Celisa Aircraft LLC: USA
3.	Operator	:	M/s Air India Limited; New Delhi
4.	Pilot in Command	:	ATPL Holder
	Extent of Injuries	:	Nil
5.	Co-pilot	:	ATPL Holder
	Extent of Injuries	:	Nil
6.	Cabin Crew	:	10
	Extent of Injuries	:	Nil
7.	Passengers Onboard	:	206
	Extent of Injuries	:	Nil
8.	Place of Incident	:	Kolkata Airport
9.	Last Point of Departure	:	Delhi Airport
10.	Point of Intended Landing	:	Changi Airport, Singapore
11.	Type of Operation	:	Schedule Flight
12.	Type of Incident	:	Smoke in cockpit & Cabin
13.	Phase of Operation	:	En-route
14.	Date & Time of Incident	:	16.07.2018 & 1952 UTC

All the time in this report is in UTC

SYNOPSIS

M/s Air India Airbus B787 aircraft VT-ANE operating flight AI 380, sector Delhi to Singapore diverted due in-flight smoke in Cabin and cockpit and made an emergency landing at Kolkata on 16.07.2018.

There were 206 pax and 10 crew on board the flight. The crew declared "MAYDAY" and landed safely at Kolkata airport. There was no injury to any occupants onboard the aircraft.

Post landing, during inspection of aircraft in LH Air conditioning bay, the AME observed Left CAC (Cabin Air Compressor) inlet Y-Duct, inlet housing and interfacing boot damaged and torn with burn and overheat signs. Post rectification action at Kolkata, the aircraft was released under MEL to Mumbai for detailed maintenance action.

DGCA ordered an Inquiry under rule 13(1) of Aircraft (Investigation of Accidents and Incidents), Rules 2017 to investigate into the causes of the incident.

The probable cause established during investigation is, "CAC surge resulted in burn/overheat of CAC inlet Y-Duct, inlet housing and interfacing boot leading to smoke and acrid smell in the cockpit and cabin".

FACTUAL INFORMATION.

1.1 History of flight

M/s Air India Airbus B787 aircraft VT-ANE operating flight AI 380 in the sector Delhi to Singapore diverted due in-flight smoke in Cabin and cockpit and made an emergency landing at Kolkata airport on 16.07.2018.

Boeing 787 Dreamliner aircraft VT-ANE had earlier operated sector Narita (Tokyo)-Delhi on the same day before operating flight AI 380, sector Delhi-Singapore. NIL snag was reported by the pilot in the previous sector. The arrival and transit checks were carried out by the qualified AME at Delhi and the aircraft was further cleared for the next departure. The operating Flight crew were ATPL holders and qualified on type. They completed all the preflight procedures and departed from Delhi at about 1745Z.

At 1900Z en-route east of Bhubaneswar at FL 390 EICAS message on PACK ACM L was received followed by a burning/acrid smell and smoke in the cockpit. The similar burning smell and smoke was reported by the cabin crew also. In 5-6 mins the smoke became intense in cabin and cockpit, the cockpit crew immediately donned the oxygen masks.

The pilot declared "MAYDAY" and decided to divert to Kolkata. Accordingly the Cabin crew, Passengers and Kolkata Flight Dispatch were informed. The crew carried out Smoke, Fire and Fumes checklist, Smoke removal checklist, over weight landing checklist. Gear were extended early, to burn more fuel, speed kept high below FL 100 and aircraft made a safe emergency landing at Kolkata airport at approx 1952Z.

The aircraft was parked at bay C3 and all passengers disembarked normally via step ladder. There was no injury to any person on board the flight.

Aircraft VT-ANE was attended by the qualified AME at Kolkata, during inspection it was observed that Left CAC inlet Y-Duct, inlet housing and interfacing boot damaged and torn with burn and overheat signs. During rectification the Y-Duct and CAC inlet housing were replaced as per recommendation of Boeing and the aircraft was released under MEL for detailed maintenance action.

There was no other damage to the aircraft and the sign of overheat/burn was localized to Y-Duct inlet housing interfacing boot.

1.2 Injuries to persons.

INJURIES	CREW	PASSENGERS	OTHERS
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/None	10	206	

1.3 Damage to aircraft:

Left CAC inlet Y-Duct, inlet housing and interfacing boot damaged and torn with burn and overheat signs.

1.4 **Other damage:**

Nil.

1.5 Personnel information

1.5.1 **Pilot-in-Command:**

Age	55 yrs
Licence	ATPL holder
Date of Issue	19.04.1988
Valid up to	06.07.2020
Category	Aeroplane
Endorsements as PIC	Pushpak, B737, A300, A330, B787
Date of last Med. Exam	21.09.2017
Med. Exam valid up to	20.09.2018
FRTO Date of issue	04.12.1981
FRTO Valid up to	03.08.2022
IR test done	04.03.2018/20.08.2018
IR test due	19.08.2019
Total flying experience	19885:00 Hrs
Experience on type	4317:00 Hrs
Experience as PIC on type	4185:00 Hrs
Last flown on type	14.07.2018
Total flying experience during last 180 days	398:45 Hrs
Total flying experience during last 90 days	166:40 Hrs
Total flying experience during last 30 days	52:50 Hrs
Total flying experience during last 07 Days	04:50 Hrs

Total flying experience during last 24 Hours	NIL

1.5.2 **Co pilot:**

Age	29 yrs
Licence	ATPL Holder
Date of Issue	01.11.2016
Valid up to	31.10.2021
Category	Aeroplane
Endorsements as PIC	Cessna 172, BN-2A-21
Endorsement as Co-Pilot	B737-800, B787-8
Date of last Med. Exam	12.10.2017
Med. Exam valid up to	11.10.2018
FRTO Date of issue	06.12.2017
FRTO Valid up to	05.12.2022
IR test done	12.04.2018
IR test due	11.10.2018
Total flying experience	3800 Hrs
Experience on type	870 Hrs
Experience as PIC on type	Nil
Total flying experience during last 180 days	437 Hrs
Total flying experience during last 90 days	220 Hrs
Total flying experience during last 30 days	72 Hrs
Total flying experience during last 07 Days	13 Hrs
Total flying experience during last 24 Hours	02 :15 Hrs

1.5.3 Scrutiny of the records revealed that both PIC/ First Officer are ATPL holders and had valid license to operate the incident flight. The Pilot in

Command and co pilot has not exceeded the flight duty time/flight time limitations laid down in the prevailing regulations.

1.6 **Aircraft information:**

1.6.1 Basic information:

Manufacturer	The Boeing company, Seattle, USA
Type	B787-8
Aircraft Serial No.	36280
Year of Manufacture	2013
Category	Normal
Sub division	Passenger/Mail/Goods.
Registration Mark	VT-ANE
Minimum Crew Required	02
Maximum All Up Weight (AUW)	2,27,930 Kg
Certificate of Airworthiness	6578 issued on 01.12.2013
Airworthiness Review Certificate	ANE/6578/ARC 2ND/2016/265 issued on 29.11.2017. Valid up to 01.12.2018
Last Major Maintenance (A1+A2+A6)	As On 19.01.2018 TSN : 17658 Hrs.

The aircraft tech log for the past six month was scrutinized. It was observed that snags pertaining to CAC L1 and cabin temperature were recorded on several occasions. These snags were subsequently cleared by the AME.

1.6.2 Similar incident occurred on Air India B787 aircraft VT-ANB on 29.10.2015, wherein the aircraft diverted and made an emergency safe landing at Kolkata. The matter was taken up with M/s Boeing during investigation. Boeing informed that the root cause of the incident is CAC surge. Failure of CAC P/N: 701010H07 is an industry issue. M/s Boeing subsequently introduced improved CAC's HO8 and HO9.

However these CAC versions H08 and H09 are also known to be susceptible to surge. M/s Boeing has communicated vide FTD 21-15002-REV 28th march 2016 about introduction of improved CAC H10 version by 4Q 2016.

In continuation with the above, M/s Boeing also advised vide FTD 21-15002 -Rev 12 0ct 2018, the introduction of Y-200 PCU software update which would increase CAC surge Margin and further prevent CAC surge. Y-200 PCU software, along with the flow sensor (SB 21-0107 replaces the flow sensor with improved PIN7010105H02) and CAC outlet check valve minimize recurrence of such events.

1.6.3 M/s Boeing has advised, time to time various measures to prevent CAC Surge issues. The compliance status of SBs/MODs by Air India, on incident aircraft VT-ANE is appended below:

i. M/s Boeing/UTAS had introduced improved CACs P/N 7010101HO9.(SB 21-0055)

The M/s Boeing SB calls for replacing existing inboard and outboard Cabin Air Compressors (CAC, P/N 7010101H07) with improved CAC P/N 7010101HO9. This SB is the subject of FAA AD 2016-25-21 (DGCA/ BOEING 787/25) to prevent an electrical short circuit from burning through the housing of the motor of the CAC. This condition, in combination with flammable fuel vapours, could result in a fire/ Overheat in the pack bay and consequent reduced controllability of the airplane. This MOD is complied on VT-ANE on 24 0ct 16.

ii. PCU OPS Software Upgrade (Y-102) as per SB210075 0R PCU OPS Software Upgrade (Y-103) as per SB210083.

PCU OPS Software has improved software logic to prevent CAC surge. This SB is the subject of FAA AD 2018-12-06 (DGCA/ BOEING 787/39). PCU Software upgrade has been accomplished on all the 8787 airplanes per ref SB B787-81205-SB210083. This MOD is complied on VT-ANE on 28 Feb 17.

iii. Installation of new CAC outlet pressure sensor J Tube Hardware as per SB210075.

The Improved outlet pressure sensor prevents blocking of the sensor caused by dirt to reduce the CAC surge. This SB is also the subject of FAA AD 2018-12-06 (DGCA/BOElNG 787/39). So far this Mod is completed on 16 airplanes in B787 fleet. This MOD is planned on VT-ANE in forthcoming "C" check in May 2019.

iv. Improved CAC flow sensor P/N 7010102H03.(SB21-0107)

The existing flow sensors P/N 7010102H02 are prone to failure due to differential expansion caused by thermal stress between the steel shaft and aluminium base of the flow sensor, vibration and fatigue damage). This causes erratic flow reading leading to the CAC surge. Boeing SB 21-0107 replaces existing flow sensors with P/N 7010102H03 which has increased joint strength and no differential expansion. This MOD is planned on VT-ANE in forthcoming "C" Check in May 2019.

v. Improved CAC outlet check valve P/N 7010105H02.(SB21-0108)

Existing CAC outlet check valve (P/N 7010105H01) failures are caused by the gradual fatigue in the aluminium flappers due to increasing open/close cycles, induced by CAC surge. This can cause reverse flow through the broken check valve from the operational CAC. The reverse flow is re-circulated through the operational CAC inlet ducting and reheating CAC air, and therefore, leading to exposure of the Y-duct to temperatures above its design limit. The new check valve (P/N 7010105H02) as per SB 21-0108 has an improved design with a stronger Corrosion Resistant Steel (CRES) housing and flappers and an increased stopper contact area for better distribution of the flapper load impact. This MOD is planned on VT-ANE in forthcoming "C" ck in May 2019.

vi. Incorporation of the Y-200 PCU software.(SB21-0109)

M/s Boeing has communicated (vide FTD 21-15002 -Rev 12 0ct 2018) introduction of Y-200 PCU software update that has further improved software logic to prevent CAC surge. This is the subject of SB 21-0109. This SB is complied on VT-ANE on 22 0ct 2018.

CAM Air India (Wide Body) has also submitted that CAC surge is an industry problem. Repeat CAC surge has resulted in collateral damage. Air India

continue to incorporate above mentioned changes into the B787 fleet for further improvements as recommended by the Manufacturer.

1.7 **Meteorological information:**

The incident flight was operating sector Delhi – Singapore, however diverted due technical emergency to Kolkata. The aircraft landed at Kolkata at 1952UTC (0122 IST). The weather at Kolkata at the time of landing was as given below:

The Met Report issued at 1900 UTC:

Wind: 170/10 Kts, Visibility: 2800 M, Weather: Hz, Cloud 1: SCT 1800feet, Cloud 2: BKN 10000 feet, Tem: 27 deg C, Dew Point: 26 deg C, QNH: 0996 hPa 29.43 INS, QFE: 0996 hPa 29.41 INS.

The Met Report issued at 1930 UTC:

Wind: 170/10 Kts, Visibility: 2800 M, Weather: Hz, Cloud 1: SCT 1800feet, Cloud 2: BKN 10000 feet, Tem: 27 deg C, Dew Point: 26 deg C, QNH: 0996 hPa 29.42 INS, QFE: 0995 hPa 29.41 INS.

1.8 **Aids to navigation:**

All navigational aids were available at the airfield and on the aircraft.

1.9 **Communications:**

There was always two way communication between the aircraft and ATC Kolkata.

1.10 **Aerodrome information:**

Kolkata International Airport is one of the busiest airports in India operated by Airport Authority of India. It is located at latitude 22°39’17”N and longitude is 088°26’48”E. it has Main Runway of orientation 01R-19L has length 3,627 m and a secondary runway 01L-19R of length 2,790 m. The airport holds a valid license issued by DGCA.

1.11 **Flight recorders:**

The aircraft is fitted with Digital Cockpit Voice Recorder and Digital Flight Data Recorder. The investigation of the CVR revealed that the crew followed all the SOP/checklists to handle the instant emergency.

The DFDR was downloaded and found no relevant parameter pertaining to the emergency.

1.12 **Wreckage and impact information:**

Not applicable.

1.13 **Medical and pathological Information:**

The operating crew underwent the Pre Flight BA Examination before operating the flight and same was negative. No post Flight PFME carried out

1.14 **Fire:**

There was no evidence of pre/post incident fire. However, during en-route flight, burning smell with smoke in the cockpit and cabin was experienced.

1.15 **Survival aspects:**

The incident was survival.

1.16 **Tests and research:** Nil

1.17 **Organizational and management information:**

Air India is the flag carrier airline of India. It is owned by Air India Limited, a government-owned enterprise, and operates a fleet of Airbus and Boeing aircraft serving number of domestic and international destinations. The airline has its operating hub at New Delhi and Mumbai. Air India is the largest international carrier out of India with 18.6% market share. Over 60 international destinations are served by Air India across four continents. Additionally, the carrier is the third largest domestic airline in India in terms of passengers carried with a market

share of 13.5% as of July 2017.The airline became the 27th member of Star Alliance on 11.07.14.

1.18 **Additional information:** Nil

1.19 **Useful or effective investigation techniques**: Nil

2. ANALYSIS

2.1 Maintenance Aspect:

2.1.1 Boeing 787-8 aircraft VT-ANE was scheduled to operate flight AI 380 in sector Delhi-Singapore on 16.07.18. Aircraft VT-ANE had earlier operated sector NRT-DEL on the same day with nil snag reported by pilot. The arrival and transit checks were carried out by the qualified AME at Delhi. The aircraft was cleared for the service without any carry forward MELs/CDL related to Air Condition System.

Post landing at Kolkata, the AME observed that the Left CAC inlet Y-Duct, inlet housing and interfacing boot damaged and torn with burn and overheat signs.

2.1.2 Analysis of maintenance record, the explanation submitted by the airlines and manufacturers service letter revealed that that the root cause of the incident is CAC surge. The surging of CAC causes the hot air to enter into the Y duct causing consequential damages. Boeing has also agreed that failure of CAC Part Number 701010H07 is an industry issue. Therefore they introduced improved CAC's H08 and H09 versions. However these CAC versions H08 and H09 are also known to be susceptible to surge. Boeing has subsequently communicated introduction of improved CAC H10 version vide FTD 21-15002-REV 28th march 2016 to be available by 4th quarter of 2016. The aircraft was installed with CAC Part Number 7010101H09, which are known to be susceptible to surge as improved version CAC H10 was not sufficiently supplied due further improvement.

Boeing, from time to time has advised various measures to prevent CAC Surge in order to further prevent hot air entering into Y duct and damaging it. The analysis of compliance status of SBs/MODs by Air India revealed many of these were not complied on the aircraft V-ANE, e.g.:

i. Installation of new CAC outlet pressure sensor 'J' Tube Hardware as per SB210075: The Improved outlet pressure sensor prevents blocking of the sensor caused by dirt to reduce the CAC surge.

ii. Improved CAC flow sensor P/N 7010102H03 (SB21-0107): The existing flow sensors P/N 7010102H02 are prone to failure due to differential expansion caused by thermal stress between the steel shaft and aluminium base of the flow sensor, vibration and fatigue damage. This causes erratic flow reading leading to the CAC surge.

iii. Improved CAC outlet check valve P/N 7010105H02 (SB21-0108): Existing CAC outlet check valve (P/N 7010105H01) failures are caused by the gradual fatigue in the aluminium flappers due to increasing open/close cycles, induced by CAC surge. This can cause reverse flow through the broken check valve from the operational CAC. The reverse flow is re-circulated through the operational CAC inlet ducting and reheating CAC air, and therefore, leading to exposure of the Y-duct to temperatures above its design limit. The new check valve (P/N 7010105H02) as per SB 21-0108 has an improved design with a stronger Corrosion Resistant Steel (CRES) housing and flappers and an increased stopper contact area for better distribution of the flapper load impact.

iv. Incorporation of the Y-200 PCU software (SB21-0109): Boeing has communicated (vide FTD 21-15002 -Rev 12 0ct 2018) introduction of Y-200 PCU software update that has further improved software logic to prevent CAC surge. Though, this SB is complied on VT-ANE after the incident flight on 22 0ct 2018.

The CAM Air India (Wide Body) further intimated that the manufacturer has agreed that CAC surge is an industry problem and repeat CAC surge has resulted in collateral damage. Air India continue to incorporate SBs/MODs into the B787 fleet upon availability of spares and implement further improvements as recommended by the Manufacturer.

From the above it is evident that the CAC surge resulted in burn/overheat of CAC inlet Y-Duct, inlet housing and interfacing boot leading to smoke and acrid smell in the cockpit and cabin.

2.2 Operational Aspect:

The pilot operating aircraft VT-ANE on 16.07.2018 was duly qualified and experienced to operate B787 aircraft. They had all other requirements such as Medical, FRTO, Instrument Ratings etc valid before operating the incident flight. It was their first flight of the day. All the pre flight procedures were followed before starting flight AI 380 in the sector Delhi to Singapore.

They took off and climbed to cruise level uneventfully. At FL 390, they observed EICAS message on PACK ACM L and simultaneously experienced burning/acrid smell and smoke in the cockpit and cabin.

On experiencing smoke and acrid smell in the cockpit and cabin, they followed Smoke Fire checklist, smoke and fumes removal checklist, over weight landing checklist and descent procedures before diverting for emergency landing to Kolkata.

In view of the above, the action followed by the pilot to land the aircraft as soon as possible is justified. There is no lapse in the operational procedure that caused the incident.

3. **CONCLUSIONS:**

3.1 **Findings:**

a) Qualified AME carried out the transit checks at Delhi and released the aircraft to operate the Sector Delhi - Singapore.

b) The aircraft was cleared for the service without any carry forward MELs/CDL related to Air Condition System.

c) The crew operating the flight was duly qualified and experienced.

d) The crew followed all the pre flight procedures before starting the flight

e) The crew took off and climbed to cruise level uneventfully. At FL 390, they observed EICAS message on PACK ACM L and simultaneously experienced burning/acrid smell and smoke in the cockpit and cabin.

f) The crew carried out Smoke Fire checklist, smoke and fumes removal checklist, over weight landing checklist and descent procedures before diverted to Kolkata.

g) A safe emergency landing was made at Kolkata airport.

h) Post landing at Kolkata airport, the AME observed that the Left CAC inlet Y-Duct, inlet housing and interfacing boot damaged and torn with burn and overheat signs.

i) In last six months, the snags pertaining to CAC L1 and cabin temperature was reported on several occasions; however the same was cleared as per the procedure.

j) The Boeing has confirmed that CAC surge is an industry issue. Surging of CAC causes the hot air to enter into the Y duct leading to subsequent damages.

k) The CAC surge resulted in burn/overheat of CAC inlet Y-Duct, inlet housing and interfacing boot leading to smoke and acrid smell in the cockpit and cabin.

l) Boeing, from time to time has advised various measures through SBs/Modifications to prevent CAC Surge in order to further prevent hot air entering into Y duct and damaging it.

m) Air India continue to incorporate SBs/MODs into the B787 fleet upon availability of spares and implement further improvements as recommended by the Manufacturer.

3.2 **Probable cause of the Incident**:

CAC surge resulted in burn/overheat of CAC inlet Y-Duct, inlet housing and interfacing boot leading to smoke and acrid smell in the cockpit and cabin.

4. **SAFETY RECOMMENDATIONS**:

NIL, as in view of Boeing, CAC Surge is an industry issue and Air India continues to incorporate SBs/MODs into the B787 fleet for further improvements as recommended by the Manufacturer.

Place: New Delhi

(Sanit Kumar)
Investigation-in-Charge