



**FINAL INVESTIGATION REPORT ON  
ACCIDENT TO GOVERNMENT OF  
UTTAR PRADESH PREMIER 1A AIRCRAFT  
VT-UPN AT IGI AIRPORT, NEW DELHI,  
ON 22/09/2012**

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**Chairman Committee of Inquiry - VT-UPN**

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**Operational Member**  
**Committee of Inquiry - VT-UPN**

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## **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 the 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 accident which may help to prevent such future accidents or incidents.*



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**FINAL INVESTIGATION REPORT ON ACCIDENT TO**  
**GOVERNMENT OF UTTAR PRADESH PREMIER 1A AIRCRAFT**  
**VT-UPN AT IGI AIRPORT, NEW DELHI, ON 22/09/2012**

1. Aircraft  
    Type : Premier 1A  
    Nationality : INDIAN  
    Registration : VT - UPN
2. Owner/ Operator : Government of Uttar Pradesh.
3. Pilot – in –Command : ATPL holder (operating aircraft under privileges of open rating below 5700 kg)
4. Extent of injuries : Nil
5. First Officer : ATPL holder (operating aircraft under privileges of open rating below 5700 kg)
6. Extent of injuries : Nil
7. Place of Accident : IGI Airport, New Delhi
8. Date & Time of Accident : 22<sup>nd</sup> Sep 2012 0600 UTC(Approx.)
9. Last point of Departure : Lucknow
10. Point of intended landing : New Delhi
11. Type of operation : Non- Schedule Operation
12. Passengers on Board : 04  
    Extent of injuries : Nil
13. Phase of operation : Landing
14. Type of Accident : Heavy landing and subsequently runway excursion

(ALL TIMINGS IN THE REPORT ARE IN UTC)



**SUMMARY:**

On 22/09/2012 Government of Uttar Pradesh (U.P.), Premier 1A, aircraft VT-UPN was operating a non-scheduled flight from Lucknow to New Delhi. There were 04 passengers and 02 crew members on board the aircraft. The aircraft took off from Lucknow at around 0500 UTC.

The enroute flight Lucknow-Delhi was uneventful. After the aircraft came in contact with Delhi Radar, the aircraft was radar vectored for intercepting the localizer and subsequently cleared for Instrument Landing System (ILS) approach for runway 27. The weather at the time of landing was fair with winds around 8-10 knots. The Vref calculated was 116 knots, however as per the Surface Movement Radar while crossing threshold runway 27 the aircraft was maintaining Vref of 120 knots (approx). At flare height the aircraft drifted towards the right of centre line. The pilot made last minute corrections by dipping the left wing tip to stabilize and bring the aircraft along the centre line. However during the process of aligning the aircraft on the centre line of the runway, the pilot could not flare the aircraft adequately and as a result the aircraft impacted heavily on the runway. The left main gear sheared off the aircraft immediately after the impact. After the left gear sheared off, the aircraft started veering towards the left of centre line. As the aircraft speed reduced, the rudders became ineffective and the aircraft veered to the left. Prior to exiting the runway the right main landing gear, which was damaged during the impact, also sheared off, thereafter the aircraft dragged on its belly before coming to final halt. The crew carried out a quick switch off and evacuated the aircraft. The ATC was informed about the accident. All the occupants of the aircraft evacuated safely. There was no fire and there was no injury to any of the occupants. Runway was closed for operations from 0600 UTC to 1300 UTC.

The Ministry of Civil Aviation constituted a committee of inquiry to investigate the cause of the accident under Aircraft (Investigation of Accidents and Incidents), Rules 2012 comprising of Sh. A X Joseph, Chairman and Capt. Pankaj Dua as operation member.



## 1. FACTUAL INFORMATION.

### 1.1 History of the flight

On 22/09/2012 Government of Uttar Pradesh Premier 1A Aircraft VT-UPN was operating a non-scheduled flight from Lucknow to Delhi. Both the cockpit crew were holding a valid ATPL license and were operating the subject flight under the privileges of open rating below 5700 kg. There was total of 06 persons on board the aircraft. The weather at the time of departure from Lucknow was fine with visibility more than 5000 m. The aircraft got airborne from Lucknow at around 0500 UTC. The en-route flight was uneventful.

After the aircraft came in contact with Delhi radar at around 0555 UTC, the aircraft was vectored for intercepting the localizer and subsequently cleared for ILS approach runway 27. The weather at the time of landing was fair with winds around 8-10 knots, visibility 3500 m. At the time of landing, the weight of aircraft was around 11300 lbs. and the Vref calculated was 116 knots. However as per the Surface Movement Radar installed at IGI airport New Delhi, while crossing threshold runway 27 the Vref was 120 knots (approx) with vertical speed of around 600 ft/min. The wind reported by ATC at the time of landing was 220/07 knots.

The pilot flying had stated that after crossing threshold at around flare out height, the aircraft drifted towards the right of center line. To control the drift the left wing tip was dipped to stabilize and to bring the aircraft along the center line. While making last minute corrections to control the flight path, the pilot could not flare the aircraft adequately and as a result the aircraft impacted heavily on the runway. On initial impact the left main landing gear sheared off from the aircraft. After the left main landing gear sheared off, the aircraft started veering towards the left of center line. The direction of the aircraft was controlled by both the cockpit crew using rudder and also raising the nose of the aircraft. After the aircraft speed reduced, the rudders became ineffective and the aircraft again started veering to the left of the center line. Prior to exiting the runway, the right landing gear which was also damaged during the initial impact, also sheared off, thereafter the aircraft dragged on its nose before coming to final halt. Both the cockpit crew carried out an emergency procedure after switching off the engines and batteries. The ATC was informed about the situation which activated the fire services. All the occupants of the aircraft evacuated safely.



There was no fire and there was no injury to any of the occupants. Due to heavy impact both the main landing gears had punctured the wing surfaces and there was heavy fuel leak from both the wings. After the fire vehicles arrived the foam was sprayed around the area to prevent any fire.

### 1.2 Injuries to persons.

INJURIES	CREW	PASSENGERS	OTHERS
FATAL	Nil	Nil	Nil
SERIOUS	Nil	Nil	Nil
MINOR/ None	Nil/02	Nil/04	----

### 1.3 Damage to aircraft.

The aircraft suffered substantial damage after the accident. The damage detail is as follows:



Final rest position of the aircraft in Kutcha (Soft Ground)



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a) Left & Right Landing Gear sheared off due to impact.

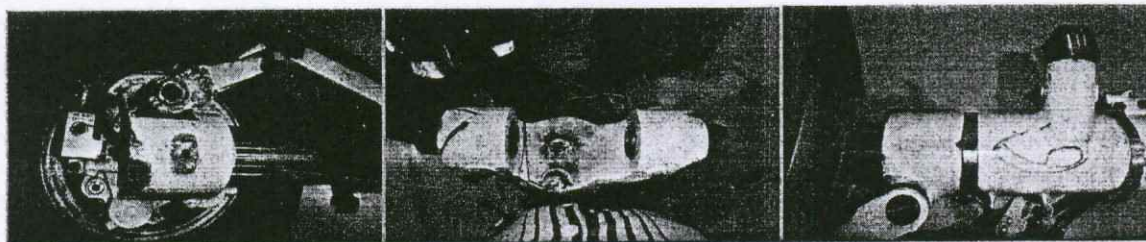


FIG-1(LH-Side View)

FIG-2 (LH-Top View)

FIG-3 (LH-Side)

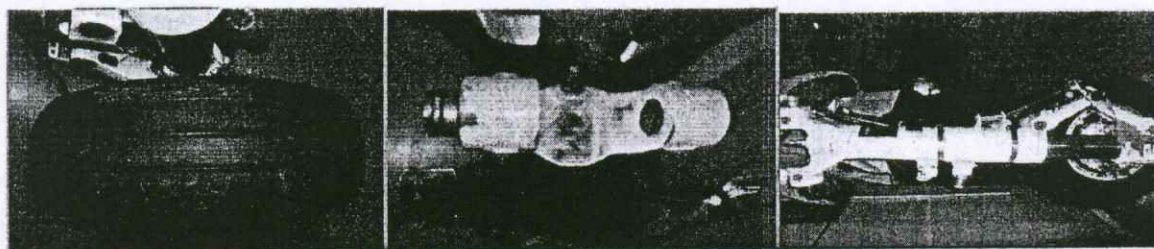


FIG-4 (LH-Full View)

FIG-5(RH-Top)

FIG-6(RH-Full View)

**Observations:**

- LH Shock strut has deep scratch, rub marks, which appears to be dragged on hard surface like concrete run way (Fig-1),
- Top view of LH & RH oleo- scratches to oleo body and pins (Fig-2,5), it suggests, this gear sheared off and dragged over concrete runway
- Fig-3, oil leak from gland seal, suggests impact;
- Fig-3, shows lower attachment point of LH Main Landing Gear's actuator;
- LH & RH tires are inflated, one cut mark on LH tire and unusual rub mark all around inboard periphery on RH tire-Fig(4)- it seems to be happened consequentially.
- Fig-6, RH full view, unlike LH, no deep scratch/rub marks, no sign of oil leak. It seems like it sheared off when aircraft off of the concrete runway.

b) LH Trunnion Support broke in two pieces.

Forward portion broken and separated, aft section (bonded and riveted-as original) with aircraft.

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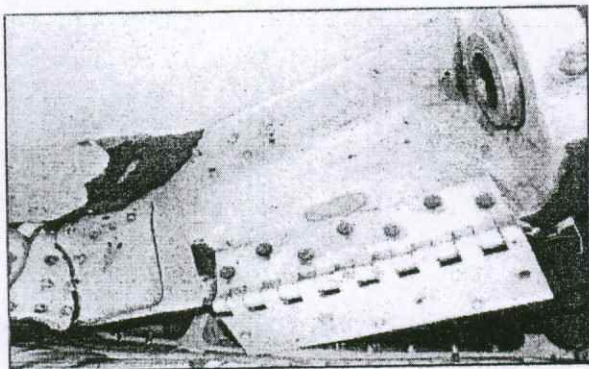


Fig-7(Side View-LH aft)

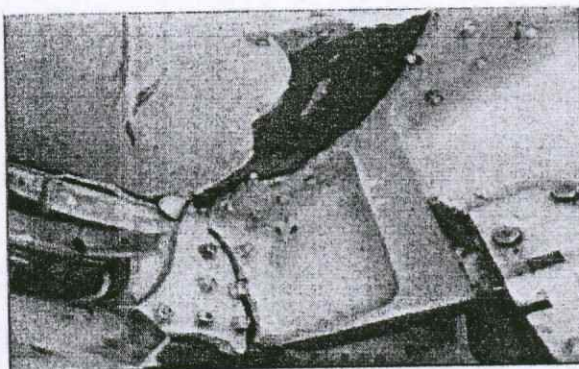


Fig-8(Side view-LH fwd)

### Observations:-

- LH Main Landing Gear fwd attachment, which is part of Trunnion- Fig-11
- Teared (FWD)/isolated portion recovered- Fig-11;
- Aft portion of Trunnion, which is MLG's aft pin attachment- Fig-7, 9, 10;
- Scratch mark over pins.

c) RH Trunnion Support broke in two pieces.

Trunnion Aft portion broke and separated, front portion with aircraft

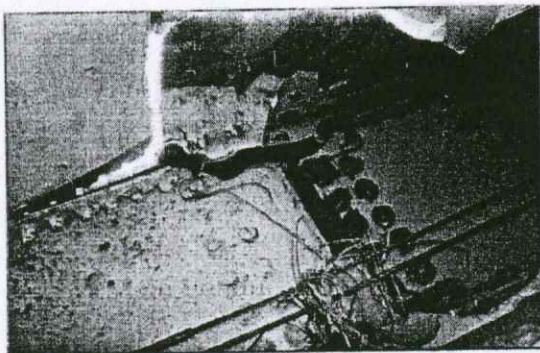


Fig-09 (RH-Side View)

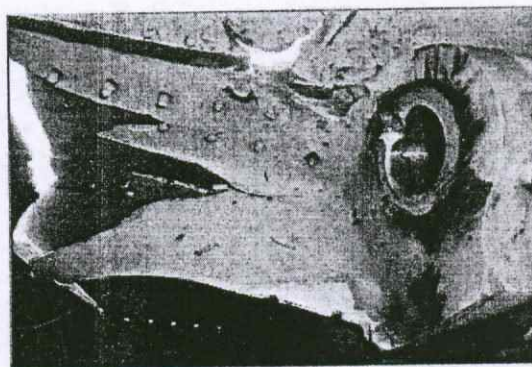


Fig-10(RH-Front-Fwd)

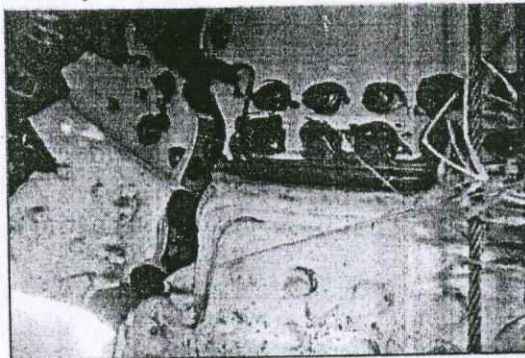


Fig-11(RH-Closure)



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**Observations:-**

- LH Wing Trunnion teared off in two parts, front one (Front Pin of MLG Pivotal support and bushing) separated and rear one with aircraft as in Picture- Fig-09,10,11
  - Top deep scratch mark over face of bushing of aft part of Trunnion.
- d) Wing Trunnion is bonded and riveted to wing skin and rear spar in which Landing gear's Pins pivot in bushings, since Trunnions are broken in two pieces landing gear sheared off, in turn, which leads to wing skin tearing in the same area where Trunnions are bonded and riveted.

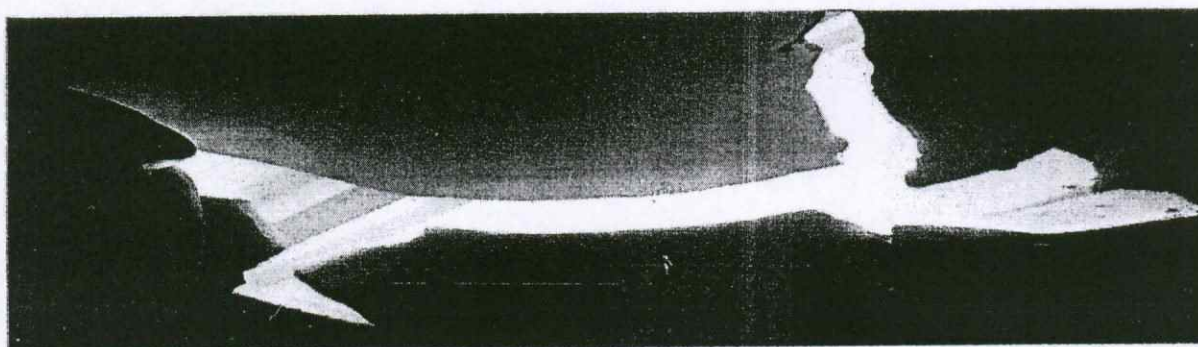


Fig-12(LH Bottom View) – Wing Skin

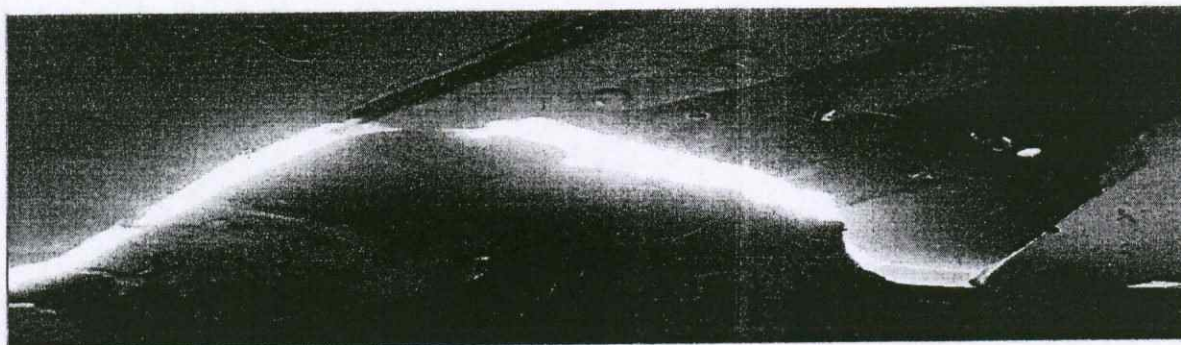


Fig-13 (RH Bottom View) – Wing Skin

**Observations:-**

- Upper wing skin both side LH and RH teared off, exactly in areas, where Trunnions are bonded and riveted to rear spar and skin
- Rivets popped-out (Visible on top surfaces).

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- (30)
- e) Aft Fuselage Shell, LH side, visible fabric clothes/tearing – Damage to Aft fuselage Shell.

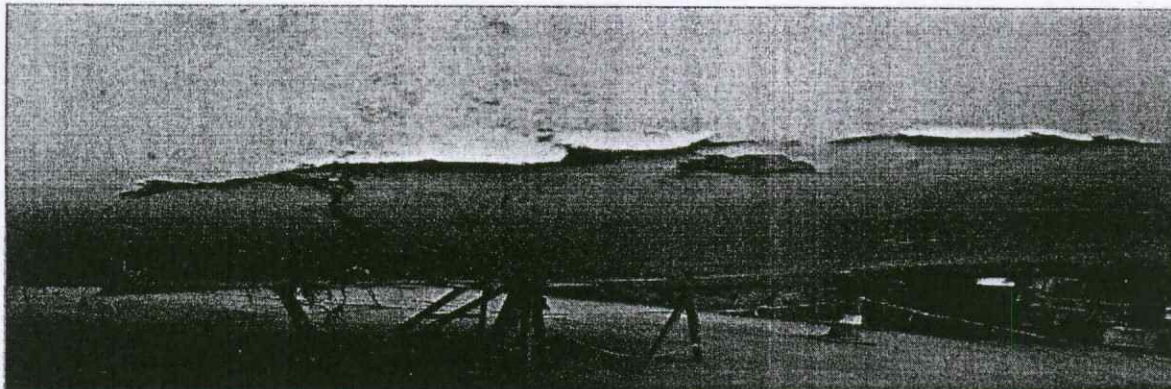


Fig-14 (Side View-LH)

**Observations:**

- Aft fuselage shell and its front attachment frame, sustained severe damage- Fig-14.
- f) LH and RH inboard and outboard flaps sustained severe damage;

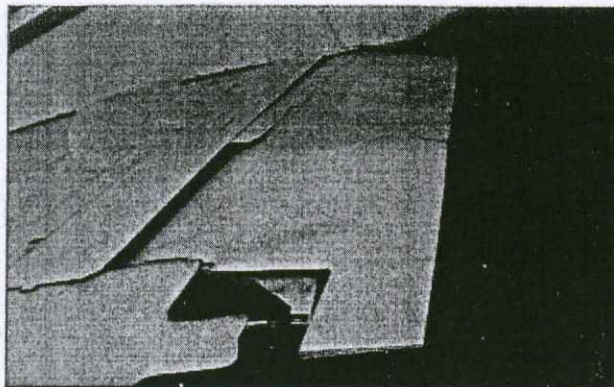


Fig-15(LH I/B Flap)



Fig-16 (LH O/B Flap)

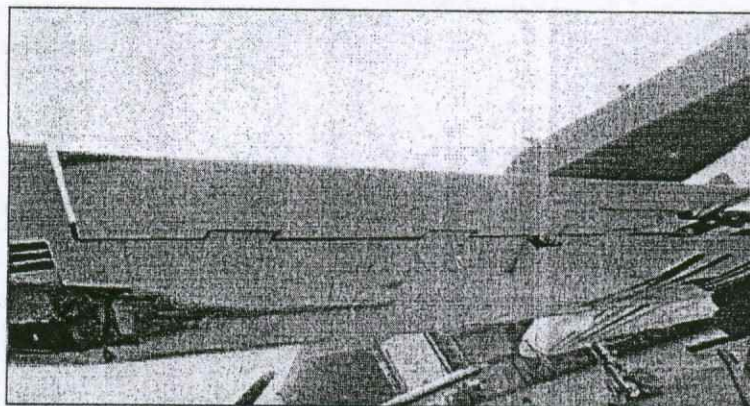
**Observations:**

- Flaps are in landing positions i.e.30 degree;
- LH and RH Flaps are heavily damaged, bent, whole mark in lower surface as visible in Fig-15,16;
- Flaps are of composite and damaged.



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g) LH and RH Ailerons sustained damage;



**Fig-17 (LH Aileron-O/B damage)**

**Observations**

- LH Aileron O/B, in Fig-17, clearly shown damaged;
- RH Aileron sustained damage;
- Both Ailerons heavily damaged.

h) Main Landing Gears inboard doors sustained severe damage;

**Observations:-**

- MLG follow-up/or outboard doors badly damaged, broken in several pieces;
- MLG LH and RH inboard doors badly damaged;
- Inboard doors are in retracted/closed position;
- MLG O/B, I/B doors and their assemblies were damaged.

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#### 1.4 Other damage:

There were deep gouges on the runway surfaces and 01 runway lights were broken.



*Gouges on the runway surfaces*



*Damaged Runway Light*

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## 1.5 Personnel information:

### 1.5.1 Pilot – in – Command:

AGE	: 44 years
Licence	: ATPL holder
Date of Issue	: 04/01/2006
Valid up to	: 03/01/2014
Category	: Aeroplane
Class	: Multi Engine Land
Endorsements as PIC	: Hawker 900 XP
<b>Aircraft flown under the</b>	<b>: Premier 1A, B 200, B 300, Beech Baron 35</b>
<b>open rating as PIC</b>	
Date of Med. Exam.	: 16/07/2012
Med. Exam valid upto	: 15/01/2013
FRTTO Licence No.	: 9381
Date of issue	: 04/01/2006
Valid up to	: 03/01/2016
Total flying experience	: 5525 hours approx
Experience on type	: 380 hours approx
Experience as PIC on type	: 250 hours approx
Last flown on type	: 08/08/2012
 Total flying experience during last 180 days	 : 37:00 hours approx
Total flying experience during last 90 days	: 26:33 hours approx.
Total flying experience during last 30 days	: 13.55 hours
Total flying experience during last 07 Days	: 01:45 hours
Total flying experience during last 24 Hours	: 01:45 hours
<b>Total flying experience during last 30 days on type</b>	<b>: NIL</b>
<b>Total flying experience during last 07 Days on type</b>	<b>: NIL</b>
<b>Total flying experience during last 24 Hours on type</b>	<b>: NIL</b>

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### 1.5.2 Co-Pilot:

AGE : 43 years  
License : ATPL holder  
Date of Issue : 23/06/2006  
Valid up to : 22/06/2014  
Category : Aeroplane  
Class : Multi Engine Land  
Endorsements as PIC : P-68C  
**Aircraft flown under the : Premier 1A, B 200, B 300**  
**open rating as PIC**  
Date of Med. Exam. : 31/12/2012  
Med. Exam valid upto : 30/06/2013  
FRTO Licence No. : 9584  
Date of issue : 23/06/2006  
Valid up to : 22/06/2016  
Total flying experience : 4817 hours  
Experience on type : 123 hours  
Experience as PIC on type : 50  
Last flown on type : 23/08/2012

Total flying experience during last 180 days : 28:00 hours  
Total flying experience during last 90 days : 25:00 hours  
Total flying experience during last 30 days : 12:50 hours  
Total flying experience during last 07 Days : 05:10 hours  
Total flying experience during last 24 Hours : 01:35 hours  
**Total flying experience during last 30 days on type : 02:45 hours**  
**Total flying experience during last 07 Days on type : NIL**  
**Total flying experience during last 24 Hours on type : NIL**

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## **1.6 Aircraft information:**

Premier 1A is a Twin engine aircraft fitted with Williams International FJ44-2A Turbofans Engine and is manufactured by Hawker Beechcraft Corporation, USA. The aircraft is certified in Normal (Passenger) category, for day and night operation under VFR & IFR. The maximum operating altitude is 41,000 feet (12497 m) and maximum takeoff weight is 5670 Kgs. Aircraft length is 14.021 meters, wingspan is 13.564 meters and height of this aircraft is 4.6634 meters. The Aircraft is approved in the "Normal" category under FAR 23.

### **Construction:**

The structure of the aircraft Premier 1A is based on Modern Technology and makes wide use of new materials. The fuselage is of carbon fiber/reinforced epoxy (CFRE) honeycomb monocoque construction. Aluminium alloy is used for the wing and other selected structure. Composite structure consisting of graphite plies and honeycomb core is used for the vertical stabilizer skin and horizontal stabilizer structure. The fuselage is a circular cabin section with a dropped aisle in the passenger cabin to provide additional headroom.

#### **a) Flight Control**

Dual mechanical controls with three-axis electrical trim operate the ailerons, rudder and elevator. The spoilers are electronically controlled and hydraulically actuated, providing a speed brake/lift dump/roll control capability. The single slotted fowler flaps are electrically controlled and driven.

The main landing gear uses an air-oil shock strut and retracts inboard into the wing centre section structure. The nose landing gear uses an oil over air shock strut and retracts forward into the fuselage. Each main wheel has anti-skid equipped brakes with independent systems and a hydraulic backup. Emergency gear extension is accomplished through a free fall system and hydraulic backup.

#### **b) Environmental**

The cabin pressure control system automatically regulates cabin air pressure to a maximum of 8.4 PSI D at an airplane altitude of 41,000 ft. Environmental control is provided by bleed air inflow for fresh air and heating and a vapour cycle system for cooling.

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**c) Engines**

Premier 1A aircraft is installed with two FJ44-2A turbofan engines manufactured by Williams Rolls, Model 390. The engines are enclosed in nacelles and are mounted to the airframe on pylons. One engine is located on each side of the upper aft fuselage. The engine is a two-spool co-rotating, axial flow turbine engine with a medium bypass ratio, mixed exhaust, and high cycle pressure ratio. The FJ44-2A produces a minimum of 2300 pounds of takeoff thrust.

The engines also provide mounting pads for electrical and hydraulic power components and bleed air for cabin pressurization, air conditioning, anti-icing, and hydraulic package pressurization. Engine driven accessories are mounted to the accessories gearbox which is secured to the bottom of the interstage housing.

Premier 1A aircraft VT-UPN (MSN. RB-236) had been manufactured in Year 2008. The aircraft was registered with DGCA under the ownership of Government of Uttar Pradesh, Civil Aviation Department, Lucknow on 10.06.2008. The aircraft is registered under category 'A' and the Certificate of Registration No. 3778.

The Certificate of Airworthiness Number 4087 under "Normal category" sub-division passenger was issued by DGCA on 10.06.2008. The specified minimum operating crew is one and the maximum all up weight is 5670 kgs (12500 lb). At the time of accident the Certificate of Airworthiness was current and was valid up to 14.05.2013. The Aircraft was holding a valid Aero Mobile Licence No. A-049/001-RLO (NR) at the time of accident. This Aircraft was operated under Operator's Permit No. 06/2012 which is valid up to 03.06.2014. As on 21<sup>st</sup> Sep 2012 the aircraft had logged 732:35 Airframe Hours.

The Premier 1A 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 Regional Airworthiness office, Lucknow.

Accordingly, the last major inspection 200 Hrs Special Inspection Schedule carried out at 721:00 Hrs/ 628 cycles on 07.08.2012. Subsequently all lower inspections, after last flight inspection and pre flight checks, were carried out as and when due before the accident. The Aircraft has last flown on 16.09.2012 Lucknow-Delhi-Lucknow.



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The aircraft was originally weighed on 31/03/2008 at Hawker Beechcraft Corporation, USA and subsequently, the weight schedule was recomputed during the issue of Indian Certificate of Airworthiness and duly approved by the office of Director of Airworthiness, DGCA, New Delhi. As per the approved weight schedule the Empty weight of the aircraft is 3806.84 kgs. Maximum fuel capacity is 1664.70 kgs. Empty weight CG is 43.90% of Mean Aerodynamic Chord (MAC). As there has not been any major modification affecting weight & balance since last weighing, hence the next weighing is due on 30/03/2013. Prior to the accident flight the weight and balance of the aircraft was well within the operating limits.

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 accident 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 accident 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.

The last fuel microbiological test was done on 13.03.2012 at Indian Oil Corporation Limited, New Delhi. DGCA approved facility and the colony count was within acceptable limits.

The Premier 1A aircraft is fitted with two tail mounted Turbofan, Williams International FJ44-2A engines manufactured by Williams Rolls, Inc. The left Engine S/N 105383 had logged 732:35 Engine Hrs and 636 cycles (As on 21/09/2012) and the right Engine S/N 105384 had logged 732:35 Hrs with 636 cycles (As on 21/09/2012). There was no defect report on the engine on the previous flight.

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### 1.7 Meteorological information:

The following is the Met report for IGI Airport, New Delhi on the date of accident between 0500 UTC to 0600 UTC.

Time (UTC)	Wind Dir	Speed (kts)	Visibility	Clouds	Temp (°C)	DP	QNH	Trend
0500	290	05	3 Km	NSC	31	21	1010	NO SIG
0530	260	06	3.5 Km	NSC	32	21	1010	NO SIG
0600	300	06	3.5 Km	NSC	32	21	1010	NO SIG

### 1.8 Aids to navigation:

The VOR/DME approaches, ILS landing facility and PAPI are available on either side of all the three runways.

**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.

Controlling Authority: Delhi International Airport Pvt. Ltd

##### Runway Orientation and dimension

Orientation- 10/28 Dimension 3810 x 45 (M)

11/29 Dimension 4430 x 60 (M)

09/27 Dimension 2813 x 45 (M)

##### Declared Distances

Rwy	TORA (M)	TODA (M)	ASDA (M)	LDA (M)
10	3810	3810	3810	3810
28	3810	4084	3810	3810
11	4110	4110	4430	3465

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29	4430	4430	4430	2970
09	2813	3246	2813	2813
27	2813	3513	2813	2661

R/W & Taxi Tracks Markings Standard as per annex- 14

Approach and Runway Lighting

RWY.	APCH LGT	THR LGT	PAPI	Rwy Centre Line LGT	RWY edge LGT
09	SALS	Yes	Yes	Yes	Yes
27	CAT-I	Yes	Yes	Yes	Yes
10	CAT-I	Yes	Yes	Yes	Yes
28	CAT IIIB	Yes	Yes	Yes	Yes
11	CAT IIIB	Yes	Yes	Yes	Yes
29	CAT IIIB	Yes	Yes	Yes	Yes

Stand by Power Supply

Secondary Power supply to all lightening and AD. Switch over time:

CAT II/CAT III 1 Sec, CAT I 15 Sec.

ATS Airspace

1. Designation Delhi CTR. 30 NM centered at DPN VOR
2. Vertical Limits SFC to FL50
3. Airspace Classification D
4. Transition Altitude 4000 FT MSL

Fire Fighting Services: CAT – 10

Met Services

Met Office Hour of service is 24 Hrs. TAF, Trend Forecast and Briefing is available. Flight documentation is provided in Chart and Tabular form in English language.

Navigation and Landing Aids

NDB, DVOR, ILS CAT-I, CAT-II, CAT-IIIA, CAT-IIIB, ASMGCS, SMR

ATS Communication Facilities

Delhi Radar 119.3/127.9 MHZ  
Delhi Flow Control 119.5 MHZ  
Delhi Approach 119.3/127.9 MHZ

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Delhi Approach/Radar	124.2/124.25/124.6/125.675/125.85 MHZ
Delhi Tower	118.1/118.25/118.75/118.825 MHZ
DATIS	126.4 MHZ
Delhi Ground	121.625/121.75/121.9 MHZ

Fuelling Facility

Hydrant and Refuellers available 24 Hrs

Fuel Type Jet A1, AVGAS 100LL

**1.11 Flight recorders:**

**1.11.1 CVR:** The Cockpit Voice Recorder was downloaded and the following observations were made.

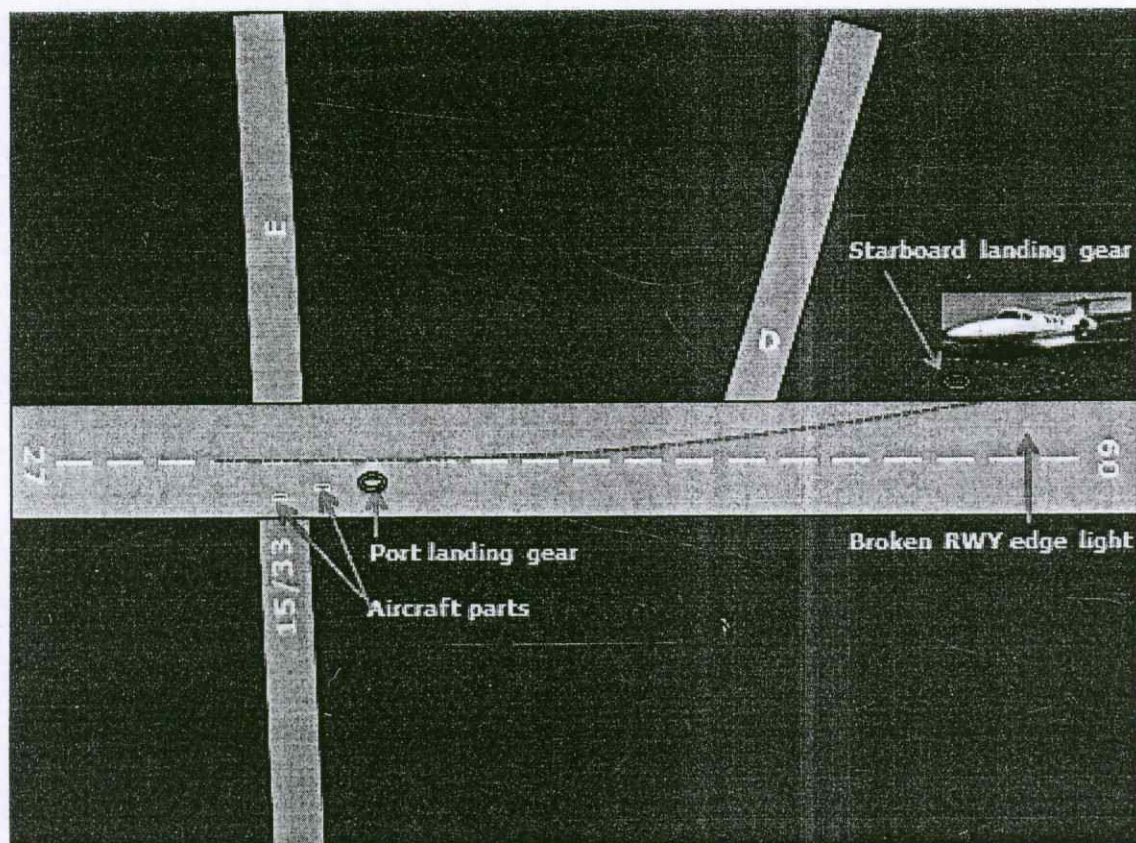
1. The Delhi Radar vectored the airplane for intercepting the localizer and subsequently ILS approach runway 27 at around 0555 UTC.
2. All the checks and procedures were standard.
3. The 500 ft auto callout was heard clearly and the Autopilot disconnect sound came after 17 seconds.
4. After touch down a thud sound was heard and the co-pilot called out to the pilot to control the directions.

**1.11.2 DFDR:** The All Up Weight (AUW) of the aircraft is below 5700 kg and as per existing CAR, the installation of DFDR was not mandatory.

**1.12 Wreckage and impact information.**

1. Aircraft final rest position was on Kutcha (soft ground area) 34.6 meters from the centre line of RWY 27.
2. The left oleo leg was found near TWY 15/ 33 intersection on the runway right of center line by 5.5 meters.
3. Undercarriage parts found scattered near the left main oleo leg within 20 meters area from the wheel.
4. Right main oleo leg found near the aircraft at 1200 meter distance from the point it touched the runway and 20 meter from aircraft final rest position.

- 5) (5)
5. While veering off the runway aircraft starboard wheel hit runway edge light.
  6. Aircraft travelled approximately 1300 meter distance from the point it touched runway before coming to complete halt with both main oleo landing gear detached from aircraft.



### 1.13 Medical and pathological Information:

Both the Commanders had undergone preflight medical check prior to the flight and was found satisfactory. After the accident the breath analyzer test was carried out for both the cockpit crew and same was found to be negative.

### 1.14 Fire:

There was no fire after the accident.

### 1.15 Survival aspects:

The accident was survivable.

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## 1.16 Tests and research:

### 1.16.1 The fractured Trunnion of left main landing gear:

The fractured Trunnion of the left landing gear was sent to the National Aerospace Laboratories (NAL), Bangalore for fracture analysis and investigation. Following observations were made in the laboratory.

#### Visual and stereo-binocular examination

The left main gear Trunnion (LH) is shown in Fig.I. Examination revealed that one of the fork arms had fractured close to the eye-end, while the other arm was found intact. In addition to the fracture of the fork arm, the Trunnion had damages in the form of fractures at various attachment points (refer Fig.II).

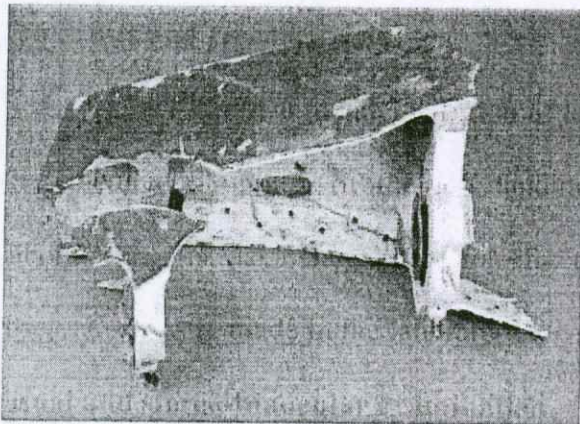


Figure I

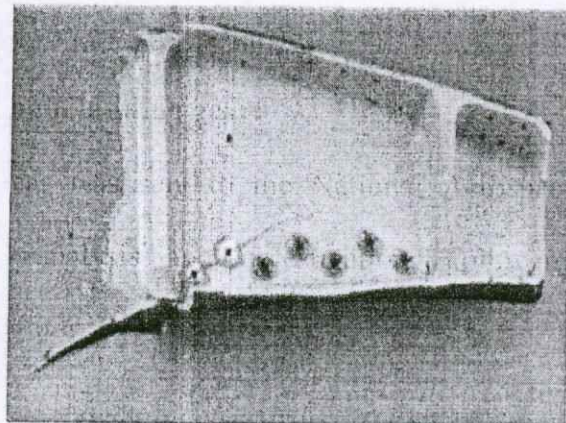


Figure II

All fracture surfaces of the Trunnion were examined under a stereo-binocular microscope. In thicker sections of the Trunnion, **the fracture surfaces showed presence of Chevron marks, typical of fast fracture in metallic materials.** Chevron marks can also be seen on the mating surfaces of the fracture at the fork arm (Fig.III). Wherever the fracture occurred in thin sections, the surfaces showed reverse slant and fish-bone type appearance. Examination also revealed presence of a crack on one of the surfaces. None of the fracture surfaces showed any evidences of progressive crack propagation.

#### Scanning electron microscopy

A sample containing the fracture initiation region marked in Fig.III was cut, cleaned ultrasonically in ethyl alcohol and examined under a scanning electron microscope (SEM).



The fracture surface showed woody structure interspersed with fine dimples, typical of overload features in wrought Al-alloys.

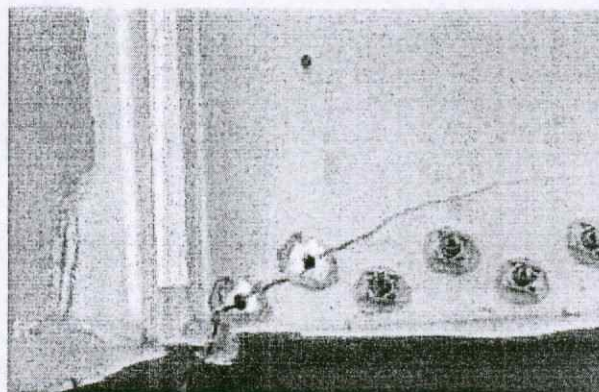
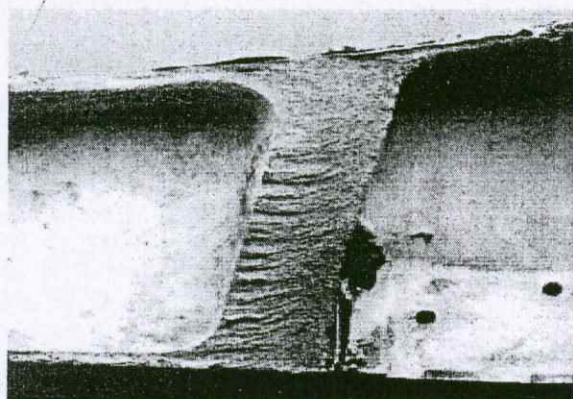


Figure III

### Microstructure, hardness & chemical composition of the Trunnion material

A sample was cut from the Trunnion and the section in the longitudinal direction of the Trunnion was prepared using standard metallographic techniques and observed under an optical microscope. Examination revealed that the microstructure consists of elongated grains of Al-rich matrix, with insoluble particles aligned along the longitudinal direction. There were no metallurgical abnormalities and the material showed a satisfactory solution treated and aged microstructure. The composition of the Trunnion material was determined using Energy Dispersive X-ray (EDX) analyzer. Analysis showed that the Trunnion was manufactured from an Al-Zn-Mg-Cu alloy. Hardness measurements were made on samples prepared from the Trunnion using a Universal Hardness Tester on Brinnell scale (2.5mm ball indenter and 62.5kg load). The sample showed an average hardness of 162 BHN.

### Analysis of Failure

**Fractographic study confirmed that Trunnion (LH) of the landing gear had fractured under overload.** Presence of Chevron marks on the fracture surfaces indicates fast propagation of cracks during fracturing of the Trunnion. **Hence, it can be concluded that the component experienced sudden overload during landing of the aircraft.**

(a) The fracture of the Trunnion (LH) was a one-time failure and had occurred under sudden overload. There were no evidences of progressive mode of failure such as fatigue and/or stress corrosion cracking.



(b) The material of construction of the Trunnion is an Al-Zn-Mg-Cu alloy belonging to 7XXX-series. **No metallurgical abnormalities in the material of construction were responsible for the failure.**

### 1.16.2 Enhanced Ground Proximity Warning System (EGPWS)

After the accident the EGPWS was downloaded at the Honeywell facility to capture the exceedances.

EGPWS part number 965-0976-040-210-210, serial number 26730, was installed in VT-UPN during the accident occurring on 22 September 2012. A flight history was download of the EGPWS. Previous to the download that an examination of the CVR revealed no recorded EGPWS warnings.

Examination of the EGPWS data shows the aircraft departed Lucknow Airport (VILK) and landed approximately 1 hour later at Indira Gandhi Airport (VIDP). The EGPWS records data by flight leg, and this flight leg was numbered by the EGPWS as Leg 608. No EGPWS alerts were recorded during Leg 608. It can be determined by the absence of any Mode 1 Sinkrate callout that descent rate at 10 feet radio altitude was less than 964 feet per minute, as this is the lower limit of the Mode I alert curve.

However, the EGPWS routinely records takeoff data (1 second after the aircraft passes above 25 feet radio altitude) and landing data (as the aircraft descends below 50 feet radio altitude). The recorded takeoff and landing data is presented in the table at the bottom of this report. The times noted in the takeoff and landing data are EGPWS system time (Hours:Minutes:Seconds) and do not relate to UTC time or date.

Takeoff data (VILK runway 27)	Landing data (VIDP runway 27)
FLIGHT LEG 608: (930:23:51) Lat/Long: 26.76046 / 80.88907 Geometric Alt: 432.00 True Hdg: -91.41 GPS Alt: 388.00 VFOM: 90.00 Pos. Uncert: 0.0112 Pos. Source: GPS1	FLIGHT LEG 608: (931:24:08) Lat/Long: 28.56977 / 77.11561 Geometric Alt: 788.00 True Mg: -88.59 GPS Alt: 760.00 VFOM: 98.00 Pos.. Uncert: 0.0105 Pos. Source: GPS1
Airport: <u>VILK</u>	Airport: VIDP



### 1.16.3 Spoiler Control Unit

The Spoiler Control Unit (SCU) 233700-109 S/N 0262 (HBC P/N. 390-384011-0019) was removed from the accident aircraft VT-UPN and sent to the manufacturer facility M/s Moog East Aurora, New York for downloading to get information regarding deployment of lift dumps. As per the report received, the Non-Volatile Random Access Memory (NVRAM) downloader was used to download information from the unit. The unit does not record a normal lift dump operation and also does not record time or date information. The fault codes stored in the NVRAM indicate violation of control parameters expected by the SCU. The before test stand calibration, Alignment Testing Programming (ATP) results indicate that the fault codes logged in NVRAM were not generated by the SCU. The after test stand calibration ATP results indicate everything was functioning normally except for the right and left midboard and outboard roll control actuators which had a small roll position accuracy error. Both errors would have been identified during the preflight check (BIT check) this combined with the NVRAM faults supports that the unit was most likely damaged on impact.

### 1.16.4 Electronic Control Unit (ECU):

Both the ECUs, LH (Part No 117162, Serial No.LH2A0533) and RH (Part No 117162, Serial No LH2A0552) for both the engines were removed and downloaded to monitor the exceedences, if occurred on the accident flight. There was no history of any exceedences recorded on both the ECUs.

### 1.17 Organizational and management information:

Government of Uttar Pradesh has a fleet of 10 aircrafts, out of which 06 fixed wing and 04 helicopters. The Aviation wing of State government is headed by the Director Aviation who reports to the Secretary, U.P. Government.

The aircraft and the helicopters are primarily utilized for the state government commitments. At the time of accident only 05 fixed wing aircraft were serviceable and 07 pilots are employed by the state government to operate the aircrafts. Except for Hawker 900 XP aircraft which is above 5700 kg all the other aircrafts are below 5700 kg and are flown by the pilots under open rating category. At the time of accident only 03 helicopters were serviceable and 08 pilots are employed by the state government to operate the helicopters.



## 1.18 Additional information:

### 1.18.1 Flight Crew Operating Procedures

As per the Flight Crew Operating Manual, the first major segment of the landing distance lies between the point 50 feet above the landing runway threshold and the point the airplane touches down. At normal landing weights (9000 -11,600 lbs), Vref would range between 107 and 121 knots. At Vref speed on a three-degree glide path the stabilized sink rate would range from 567 ft/min up to 641 ft/min (9.5 to 10.7 ft/sec). If no flare were accomplished, the airplane would touch down 951 feet from the threshold at these sink rates. Although the airplane is designed for the loads resulting from these sink rates, to provide for a more reasonable touchdown the landing distance in the Aircraft Flight Manual (AFM) accounts for a flare of two to three seconds to reduce the sink rate. The touchdown sink rate resulting from this minimum flare will be a firm landing. If the flare exceeds three seconds, the additional flare will result in increased distance from the 50 feet threshold height to touchdown. The airplane deceleration rate will be negligible in this extended flare, requiring the same braking (ground roll) distance, so this additional distance would be above and beyond that presented in the AFM.

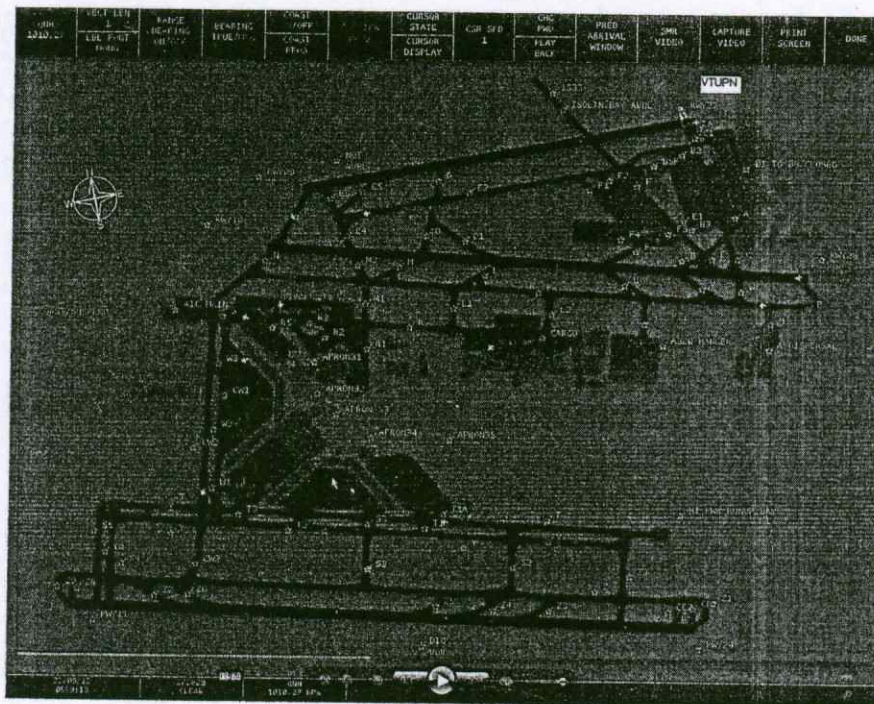
### 1.18.2 Radar Plot Measurement

The Aircraft movements were tracked on the Radar from 4.5 NM to 0.5 NM in terms of speeds and rate of descent as per the table below. Thereafter the radar pictures were taken to identify the aircraft position with ground speed.

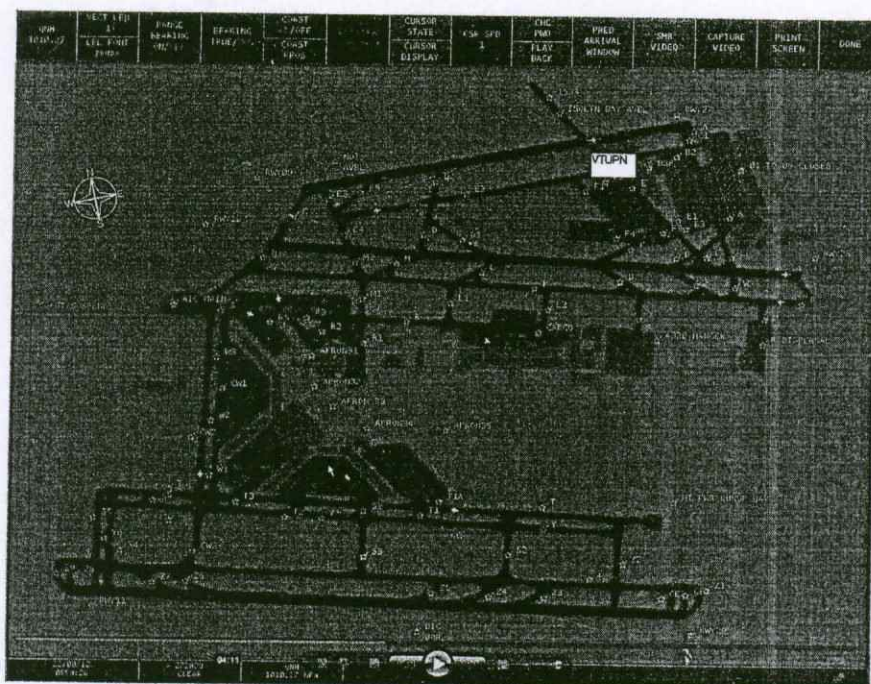
Time (UTC)	Distance (NM)	Ground Speed	Vertical Speed (Ft/Min)	Pressure Altitude
05:57:16	4.5	150	1200	2500
05:58:00	2.7	150	800	1700
05:58:12	Clear to Land	150	800	1600
05:58:30	1.5	140	700	1400
05:58:45	1	140	600	1200
05:58:55	0.5	140	600	1100



47



Pressure Altitude - 856 ft  
Ground Speed - 120 Kts

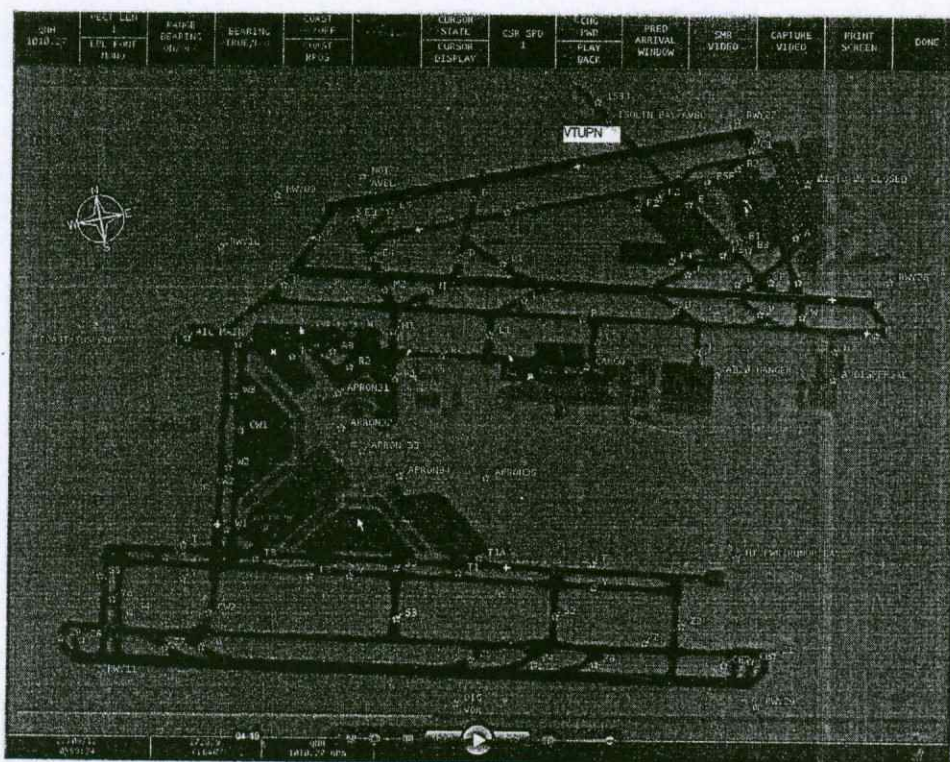


Pressure Altitude - 787 ft  
Ground Speed - 110 Kts

67



45



### 1.18.3 Privileges of Open Rating:

During examination of both the crew flying licenses, it was observed that both the operating crew had undertaken the flight under the privileges of open rating to fly all conventional aircraft below 5700 kgs. The pilot flying was endorsed as PIC on Hawker 900 XP and was flying as PIC on Premier 1A, B200, B300 and Beech Baron 35 under the privileges of open rating. The co-pilot was endorsed as co-pilot on Hawker 900 XP and was flying as PIC on Premier 1A, B200 and B300 under the privileges of open rating.

As per The Aircraft Rules 1937 Schedule II, Section M, Para 4 (a) states *"The licence shall indicate the class and the types of aeroplanes the holder is entitled to fly. An open rating for all types of aeroplanes having all-up-weight not exceeding five thousand seven hundred Kgs. may also be granted if he has completed not less than one thousand hours of flight time as a Pilot-in-Command on any aeroplane having an all-up-weight of fourteen thousand Kgs. or above."*

88



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Aeronautic Information Circular (AIC) 03 of 1985 states *"In exercise of the powers conferred by Section 5A of the aircraft act, 1934 (22 of 1934), the Director General of Civil Aviation being satisfied that for securing the safety of aircraft operations, it is necessary to do so, hereby directs that with immediate effect no person holding an Open Rating endorsement on the Pilot's Licence shall exercise the privileges of that rating on any aircraft not flown by him, unless he carries out familiarisation flight(s) with the Flight Instructor or an experienced pilot duly authorised to do so on that type of aircraft, provided that such pilot has flown that type and has at least three hours Pilot-in-Command experience within a period of six months, immediately preceding the date of the familiarisation flight(s) on an aircraft appropriate to that weight category "*

In this particular case the PIC had not flown this aircraft for last one and half month approx. However as per DGCA Operations Circular 02 of 2004, *the recency requirement is only when a pilot has not flown the aircraft for more than 03 months.*

As per The Aircraft Rules 1937 Schedule II, Section O, Para 5 states *"Provided further that a pilot, who has demonstrated his competency by undergoing an Instrument Rating Flight test on a Multi-engine aeroplane not exceeding an all-up-weight of five thousand seven hundred Kgs., shall exercise the privileges of his Instrument Rating on all multi-engine aeroplanes within the aforesaid weight category."*

In this particular case both the cockpit crew had carried out their instrument rating checks on B-200 aircraft and using the privileges of aforesaid rule to fly Premier 1A aircraft without any instrument rating checks. It is also mentioned that Premier 1A aircraft is a full glass cockpit with Flight Management System (FMS) and is certified to fly RVSM levels with Mach cruising speed of 0.8. Beechcraft B-200 aircraft is a turbo prop aircraft having a semi glass cockpit with no FMS and is not certified to fly RVSM levels with Mach cruising speed of 0.52.

1.19 Useful or effective investigation techniques: NIL

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## 2. ANALYSIS

### 2.1 Serviceability of the aircraft:

Premier 1A aircraft VT-UPN (MSN. RB-236) had been manufactured in Year 2008. The aircraft is registered with DGCA under Certificate of Registration No. 3778 with the ownership of Government of Uttar Pradesh, Civil Aviation Department, Lucknow on 10.06.2008 under category 'A', Normal sub division passenger.

At the time of accident the Certificate of Airworthiness was current and was valid up to 14.05.2013. The Aircraft was holding a valid Aero Mobile Licence No. A-049/001-RLO (NR) at the time of accident. The Operator's Permit No. is 06/2012 was valid on the day of accident. As on 21<sup>st</sup> Sep 2012 the aircraft had logged 732:35 Airframe Hours.

The aircraft was originally weighed on 31/03/2008 at Hawker Beechcraft Corporation, USA and subsequently, the weight schedule was recomputed during the issue of Indian Certificate of Airworthiness and duly approved by the office of Director of Airworthiness, DGCA, New Delhi. As per the approved weight schedule the Empty weight of the aircraft is 3806.84 kgs. Maximum fuel capacity is 1664.70 kgs. Empty weight CG is 43.90% of Mean Aerodynamic Chord (MAC). As there has not been any major modification affecting weight & balance since last weighing, hence the next weighing is due on 30/03/2013. Prior to the accident flight the weight and balance of the aircraft was well within the operating limits.

All Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine had been complied on the aircraft. Prior to the accident 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 accident flight.

The last fuel microbiological test was done on 13.03.2012 at Indian Oil Corporation Limited, New Delhi. DGCA approved facility and the colony count was within acceptable limits. There was no pending defect/MEL on the aircraft prior to flight.

Examination of the aircraft at the site revealed that it was confined around its final rest position and there was no in-flight disintegration of any part of the aircraft.



(57)

In view of the above, it is inferred that the serviceability of the aircraft is not a factor to the accident.

## **2.2 Weather:**

The weather at the time of takeoff from Lucknow was fine with fair visibility. The aircraft took off from Lucknow at around 0500 UTC. The weather at Delhi was reported fine with visibility 3.5 kilometers and clear skies. The winds reported for runway 27 was 250<sup>0</sup>/10 kts. The temperature and QNH reported by the ATC was 32<sup>0</sup> and 1010 hpa. There was no significant changes in the weather from the previous METAR. The winds reported by ATC just prior to landing was 220/07 kts. There was no significant weather changes reported by the ATC prior to landing.

From the foregoing, it is inferred that weather is not a contributory factor to the accident.

**2.3 Privileges of Open Rating:** During investigation, it was observed that both the operating crew had undertaken the flight under the privileges of open rating to fly all conventional aircraft below 5700 kgs. The pilot flying was endorsed as PIC on Hawker 900 XP and was flying Premier 1A, B200, B300 and Beech Baron 35 under the privileges of open rating. The co-pilot was endorsed as co-pilot on Hawker 900 XP and was flying as PIC on Premier 1A, B200 and B300 under the privileges of open rating.

The Aircraft Rules 1937 Schedule II, Section M, Para 4 (a) permits a holder of open rating to fly all types of aeroplanes having all-up-weight not exceeding five thousand seven hundred Kgs. Further as per The Aircraft Rules 1937 Schedule II, Section O, Para 5 permits that a pilot, who has demonstrated his competency by undergoing an Instrument Rating (IR) Flight test on a Multi-engine aeroplane not exceeding an all-up-weight of five thousand seven hundred Kgs., shall exercise the privileges of his Instrument Rating on all multi-engine aeroplanes within the aforesaid weight category."

In this particular case both the cockpit crew had carried out their IR checks on B-200 aircraft and using the privileges of aforesaid rule to fly Premier 1A aircraft. It is also mentioned that Premier 1A aircraft has a full glass cockpit with Flight Management System

(91)



(52)

(FMS) and is certified to fly RVSM levels with ceiling altitude of 41,000 ft maintaining Mach speed of 0.80. However a B-200 aircraft is a semi glass cockpit with no FMS and is not certified to fly RVSM levels. The maximum Mach Speed it can cruise is 0.52.

#### **2.4 Pilot handling of the aircraft:**

Previous to the accident flight, the pilot had operated a flight (Lucknow-Delhi-Lucknow) on 21.09.2012 on Hawker 900 XP. The pilot had not flown the involved accident aircraft VT-UPN for last one and half month approx.

The aircraft VT-UPN was last utilized on 16.09.2012, there was no snag reported by the pilot on the completion of the flight. Subsequently the aircraft was scheduled to operate Lucknow-Delhi-Lucknow around 0500 UTC on 22.09.2012 with 04 passengers on board. The weather at Lucknow was fair with good visibility. The aircraft took off from Lucknow at around 0500 UTC.

The flight from Lucknow to Delhi was uneventful. The Delhi Radar vectored the airplane for intercepting the localizer and subsequently ILS approach runway 27 at around 0555 UTC. The weather at the time of landing was fair with winds around 8-10 knots, visibility 3500 m. The landing weight of aircraft was around 11300 lbs. and the Vref calculated was 116 knots. As per the Surface Movement Radar installed at IGI airport New Delhi, while crossing threshold runway 27 the Vref was 120 knots (approx.) with vertical speed of around 600 ft/min. The wind reported by ATC at the time of landing was 220/07 knots.

As per the Flight Crew Operating Manual, the first major segment of the landing distance lies between the point 50 feet above the landing runway threshold and the point the airplane touches down. At normal landing weights (9000 -11,600 lbs), Vref would range between 107 and 121 knots. At Vref speed on a three-degree glide path the stabilized sink rate would range from 567 ft/min up to 641 ft/min (9.5 to 10.7 ft/sec). Although the airplane is designed for the loads resulting from these sink rates, for a more reasonable touchdown, a flare of two to three seconds is recommended to reduce the sink rate. The touchdown sink rate resulting from this minimum flare will be a firm landing.

(92)



After crossing threshold prior to flaring the aircraft for landing at around flare out height, the pilot observed the aircraft drifting towards the right of center line. A slight left wing tip was dipped by the pilot to stabilize the aircraft and bring the aircraft along the center line. However in the process of correction, the pilot could not flare out the aircraft adequately and consequently the main landing gear impacted the runway heavily. The left landing gear got sheared off from the aircraft after the impact. After the left gear sheared off, the aircraft started veering towards the left of center line. The direction of the aircraft was controlled on the center line by both the cockpit crew using rudder and also raising the nose of the aircraft. After the aircraft speed reduced, the rudders became ineffective and the aircraft again started veering to the left. Prior to exiting the runway the right landing gear, which had also got damaged on impact touchdown, sheared off. Thereafter the aircraft dragged on its belly before coming to final halt. Both the cockpit crew carried out a quick switching off the engines and batteries and emergency evacuation was carried out.

From the above it is evident that after crossing the runway threshold and prior to flaring the aircraft, the pilot in the process of aligning the aircraft on the center line of the runway made last minutes corrections and in the process could not adequately flare the aircraft, which resulted into a heavy touchdown.

Hence handling of the aircraft by the Pilot is a contributory factor to the accident.

## **2.5 Circumstances leading to the Accident :**

After the ATC vectored VT-UPN for ILS approach runway 27, the aircraft maintained the approach profile. While crossing threshold at around flare out height, the pilot observed that the aircraft was drifting towards the right of center line. The pilot dipped the left wing tip to stabilize and bring the aircraft along the center line and in the process could not flare the aircraft adequately as a result the main landing gear impacted the runway heavily and subsequently resulted into a heavy landing. The left landing gear sheared off during initial impact, the aircraft rolled for some distance and thereafter started veering towards the left of center line. The direction control was maintained by both the cockpit crew. However as the aircraft speed reduced, the rudders became ineffective and the aircraft again started veering to the left of center line. Thereafter the aircraft exited the runway and came to final halt in the soft ground.



### 3 CONCLUSIONS:

#### 3.1 Findings:

- a) The Certificate of Airworthiness and the Certificate of Registration of the aircraft was valid on the date of accident.
- b) The certificate of flight release was valid on the day of accident.
- c) Both the cockpit crew were operating the flight under the privileges of open rating for conventional aircraft below 5700 kgs.
- d) Both the cockpit crew had carried out their Instrument Rating checks on B 200 aircraft. However under the privilege of The Aircraft Rules 1937 Schedule II, Section M, Para 4 (a) they were flying Premier 1A aircraft.
- e) All the concerned Airworthiness Directive, Service Bulletins, DGCA Mandatory Modifications on this aircraft and its engine were found complied with.
- f) Prior to the accident flight the same pilot had operated a flight Lucknow-Delhi-Lucknow on Hawker 900 XP. He had not flown the involved accident aircraft for last one and half month (approx).
- g) The aircraft came in contact with Delhi Radar at around 0555 UTC and was vectored for runway 27.
- h) The landing weight of the aircraft was around 11300 lbs and the Vref calculated was 116 kts, however the aircraft was maintaining around 120 kts.
- i) During short finals, the aircraft was maintaining ROD of around 600 ft/min. After crossing runway threshold the pilot made corrections to align the aircraft to the centerline due to drift and in the process could not flare the aircraft adequately which resulted into a heavy landing.
- j) The left landing gear got dislodged on initial impact with the runway and thereafter the directional control was maintained by rudder application. Prior to exiting the runway the right landing gear also sheared off.
- k) The left main landing gear trunnion was sent to the National Aerospace Laboratories for fracture analysis. As per the report, the fracture of the Trunnion (LH) was a one-time failure and had occurred under sudden overload. There were no evidences of progressive mode of failure such as fatigue and/or stress corrosion cracking.



- l) The EGPWS was downloaded at the Honeywell facility and no exceedences were recorded.
- m) The SCU was downloaded at the M/s Moog facility, New York, USA and no exceedences were recorded.
- n) The Electronic Engine Control Unit was downloaded and no exceedences were recorded.
- o) There was no fire and no injury to any of the occupants on board the aircraft.
- p) Weather was not a contributory factor to the accident.

### 3.2 Probable cause of the accident:

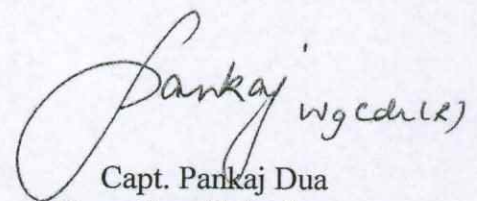
After crossing the runway threshold, the pilot made corrections to control the drift and in the process of aligning the aircraft to the center line of the runway could not flare out the aircraft adequately, which resulted in to a heavy touchdown.

### 4 SAFETY RECOMMENDATIONS:

- 1. Considering modern day jet aircraft below 5700 kgs, DGCA may relook the rules existing thereof for the privileges of open rating in terms of the aircraft to be considered under conventional category.



(A. X. Joseph)  
Assistant Director-AAIB  
Chairman Committee of Inquiry - VT-UPN



Capt. Pankaj Dua  
Operational Member  
Committee of Inquiry - VT-UPN

Place: New Delhi  
Date : 13/11/13