



PAKISTAN CIVIL AVIATION AUTHORITY
(SAFETY & INVESTIGATION BOARD)



**INCIDENT TO MIS. HYBRID AVIATION'S AIRCRAFT
CESSNA- 310, REG. NO. AP-BCR ON 14 OCTOBER 2008
AT
WALTON AIRPORT, LAHORE**

FINAL REPORT

INCIDENT TO M/S. HYBRID AVIATION'S AIRCRAFT CESSNA- 310 REG. NO. AP-BCR AT WALTON.. LAHORE ON 14TH OCTOBER, 2008

Authority: Director General Civil Aviation Authority Memorandum No.
HQCAA/1901/325/SIB dated 15th October 2008 (**Appendix 'A'**).

Synopsis

On 14 Oct 2008, a Cessna 310, registration No. AP-BCR, belonging to Hybrid Aviation was scheduled for "ATPL training flying" at Walton Airport Lahore. The aircraft took off at 1110 hrs (PST) from AllAP Lahore for circuit landings at Walton Airport. It flew for 2 Hours and made 5 landings at Walton without any event. However when the gears were lowered for a full stop landing, the **"gears down and locked safe light"** did not come ON. Hence the gears were recycled, but the light **did not come ON**. A visual check revealed the gears to be down and probably locked. Therefore, a full stop landing was made. After a smooth touch-down, the aircraft rolled for about 1400 feet and at about 40-50 MPH of speed, started to veer to the right side with the right wing dropping and ultimately came to rest with right gear collapsed. The right engine propeller, right landing gear linkages, door and panels sustained damages, however the aircrew remained unhurt.

1. Factual Information

1.1 **Aircraft Information:** Certificate of Airworthiness was found valid since its induction in Pakistan. **See Appendix 'C'**.

1.1.1	Registration Marking	:	AP-BCR
1.1.2	Aircraft Inducted in Hybrid	:	01-12-2000.
1.1.3	Aircraft Make and Model	:	CESSNA 310 F
1.1.4	Manufacture Serial No.	:	310F-0100
1.1.5	Engine Make and Model	:	CONTINENTAL IO-470-D
1.1.6	Engine Serial No.	:	No. 1 Eng. S No.105645-R
		:	No. 2 Eng. S No.105636-R
1.1.7	Time Since Overhaul	:	No. 1 932:15
		:	No. 2 962:45

1.1.8	Prop.(Hartzel) time since OH	No. 1 prop, 327:40 hrs
		No. 2 prop, 327:40 hrs
1.1.9	Certificate of Airworthiness	Issued on 12-6-2008
1.1.9.1	Date of Issue	12-06-2008
1.1.9.2	Date of Expiry	12-06-2009
1.1.9.3	Year of Manufacture	1961
1.1.9.4	Name and Address of the owner	Hybrid Aviation, Lahore
1.1.9.5	Airframe History:	
1.1.9.6	Total Hours	5120:15
		As on 14.10.2008
1.1.9.7	Total Landings	96 since last C of A
1.1.9.8	Record of Last Inspections:	
	Check 'I'	On 02-07-08 at 50:00 hours
	Check 'II' hours	On 30-08-08 at 100:00
	Check 'III'	at 600:00 hours

1.2 **Aircraft Wreckage:** Aircraft sustained minor damages which have been preserved through photographs at **Appendix 'N'**. There was no fire, no separation of parts or major structural damage. The aircraft was in one piece.

1.3 **Crew Information:** The aircrew was taken for medical examination and all results were negative. **See Appendix '8'**.

1.3.1 **Pilot In-Command**

1.3.1.1	Name	Captain Amin Pasha
1.3.1.2	Position in the Cockpit	Right Side
1.3.1.3	Date of Birth	26.01.1959
1.3.1.4	Type of Licence held and No.:	ATPL No. 866
1.3.1.5	Medical date with status:	Class 1 valid up to April, 2009

1.3.2 **Rating**

1.3.2.1	Cessna 150, 152, 180 and C-310	
1.3.2.2	Type Current	All above except C-180
1.3.2.3	Flight Instructor Rating	Nil

1.3.3 Flying Experience

1.3.3.1	Grand Total	8500 Hrs
1.3.3.2	Total in Command	8300 Hrs
1.3.3.3	Total in Command on C-310:	110 Hrs
1.3.3.4	Where Trained	Multan Flying Club
1.3.3.5	Date of Joining	1987 as CF!

1.3.4 Co-Pilot

1.3.4.1	Name	1 st Off. Salman Aslam
1.3.4.2	Position in the Cockpit	Left Side
1.3.4.3	Date of Birth	26-03-1960
1.3.4.4	Type of Licence held and No:	CPL No. 2600 Class 1 Medical valid up to 31-03-2009.

1.3.5 Rating

1.3.5.1	Type(s) held	A- 319,320,321
1.3.5.2	Type Current	A-319, 320,321
1.3.5.3	Flight Instructor Rating	Nil

1.3.6 Flying Experience

1.3.6.1	Grand Total	2913
1.3.6.2	Total on C-310	2:0

1.4 **History of Flight:** The Aircraft was flying on a training flight.

1.5 **Injury to Persons:** Nil

1.6 **Damage to Aircraft:** Minor damage

1.7 **Other Damages:** No co-lateral damage

1.8 **Met,rological Condition:** Fair weather.

1.9 **Communication:** Serviceable VHF Radio

1.10 **Aerodrome and Ground Facilities:** Communication facilities were serviceable and available but could not be used for emergency due to "Electricity Load Shedding"

1.11 **Flight Recorders:** Not installed

1.12 **Impact Information:** The right gear collapsed about 1400 feet down the Runway.

2 Technical Investigation

2.1 Objectives

2.1.1 The technical investigation was focused to answer the following primary questions:-

- (a) Whether the right gear collapsed due to a material failure?
- (b) Or the gear collapsed due to the inadequacies in the maintenance system such as component malfunction due human error' violation of SOP or AMM Procedures etc

2.2 The beginning

2.2.1 In order to appreciate the nature of occurrence it is pertinent to understand the "Landing Gear System" of Cessna C 310. The main landing gear retracting linkage consists of push-pull tubes, bell cranks, torque tubes, braces, and links, interconnected between the landing gear actuator and the main landing gear. A positive downlock is obtained by rigging the main side links to an over-center position. The link assemblies which hold the main side links in an over-center position are also rigged over-center. Downlock springs, which apply spring tension to the over-center position of the link assemblies, are provided as an added safety feature. Hook-type mechanical locks are provided to lock the landing gear in its retracted position. The main landing gear retracting linkage also operates the main landing gear door operating mechanism. There is no hydraulic or pneumatics involved. The electric motor, installed under the left seat, is connected to the landing gears through torque tubes, which move in and out for extension and retraction of the gears (See Appendix 'K', & 'L').

2.2.2 The aircraft "**Certificate of Airworthiness**" was updated and valid (Appendix 'C'). The analysis of pilot reported defects did not reveal any defect which could have any attribution to the event. (Appendix 'D'). The daily inspection and certificate of Release to Service on 14-10-2008 was completed in all aspects of inspections and maintenance records. (See Appendix 'E'). The last 50 Hours or 30 Days inspection records also did not reveal any defects in the landing gears operation. (Appendix 'F').

2.2.3 Analysis of the "Renewal of Maintenance Organisation Approval" indicted that there were number of general weaknesses in the maintenance practices at Hybrid Aviation. These included poor house keeping, shortage of required technical manpower and lack of technical literature and maintenance of tools. (See Appendix 'G').

2.2.4 During investigation, the aircraft was jacked up and the linkage to right landing gear was by passed. The operation of electrical motor, gears and landing gear extension/retraction was observed. The motor, gear system and retraction/extension system were found without any defect. However the landing gear light was not illuminating. The collapsed landing gear was analysed and the following was observed:

- (a) The two connecting rods between the torque tube and the gear were found bent under compression, despite the fact that there was no post impact damage in the area. Bending of both rods indicated that extensive compression forces were exerted on these rods during the inadvertent collapsing.
- (b) The Torque Link, which ensures that the wheel remains straight and does not swirl around its axis, was also found dislodged. The tyre, the ground marks and wrapping of brake line around the oleo also indicated that the wheel had swirled around its axis, during the landing roll.
- (c) The right gear door was found closed and smashed inside the wheel well, indicating that the wheel had forced it into the wheel well when the door was in closed position. This could have happened when the aircraft had landed and its gear collapsed and struck the door forcing it into the wheel well.

2.3 Probable Causes for Rt. Gear Collapse

2.3.1 Improper rigging of the landing gear system.

2.3.2 Failure of torque link hindering positive down locking of landing gear and permitting swirling of the wheel on ground. It can also affect the landing gear indication system.

2.4 Improper Rigging of Ldg. Gear System.

2.4.1 The records show that the rigging was positive. It was also observed during operational checks of the landing gears operation that the linkages were free of any obstruction and were moving correctly (See Photographs for system description and damage details).

25 Breakage of Torque Link

2.5.1 On examination after the occurrence it was observed that both braces of the torque link had separated and the bolt and nut assembly which runs through upper brace of lower link and lower brace of upper link to lock the landing gear against rotation; were hanging with the upper brace. However the respective washers and bush(sleeve) were missing. There was no other evidence of any local damage which could indicate its forced dislocation or pulling out of the linkage assembly. It appeared that either the bush and washer were not installed, permitting its dislodging from the torque link or these objects lost their material strength and failed during normal use. The design and physical arrangement of parts once assembled make it inconceivable that the **"Bush"** can leave its place without disassembly of the torque link. Mr Randall Mainquist, supervisor, Engineering, Cessna Air Safety Investigations, USA was contacted for advice. (**Appendix 'M'**). He provided following answers to our queries:

- (a) If the **Washers, nut, bolt, and cotter pin** are installed per the maintenance manual, the bushing cannot work itself out. If the washers are not installed, or have failed, then it is possible that the bushing could work itself out from the forging.
- (b) Disengagement of the torque link, partially or totally, will not cause the landing gear light to flicker.

2.5.2 Hence in the light of manufacturer's advice there are two probabilities for torque link failure which contributed to the occurrence. Firstly the possibility of a maintenance malpractice where the assembly is not carried out in accordance with Aircraft Maintenance Manual. It was noted that the system has been working for a long time without any maintenance or aircrew reported defect /observation but possibility of a un documented maintenance activity can not be ruled out. The second possibility is that of **"Washers Failure" due to material failure or improper installation or installation of washers of improper sizes.**

3. Ops Analysis

3.1 Ops analysis was done with a view to find if the occurrence was pilot induced, and or the pilots had a role to aggravate the emergency by improper emergency handling. It was also intended to determine whether or not some other operational factors were responsible to have either caused or aggravated the occurrence/emergency.

3.2 In order to determine that, the following domains were critically analysed.

- (a) Aircrew History and Background
- (b) Aerodrome weather
- (c) Onset of emergency
- (d) Sequence of Events
- (e) Emergency Handling by Aircrew
- (f) Role of ATC
- (g) SMS Implementation Programme

3.3 Aircrew History and Background

3.3.1 **The Captain:** Capt Amin Pasha, ATPL- 866 is 50 years old and is flying regularly with Multan Flying Club. To date, he had a grand total of 8500 Hrs on various types of aircraft with 110 Hrs as Capt on C-310 aircraft. He belonged to Multan and therefore was requested to come to Lahore by Hybrid Aviation to fly a check sortie with First Officer Salman Aslam of Air Blue. He has a valid ATPL and possesses class I valid medical category and was fully fit to undertake this flight.

3.3.2 **The Co-Pilot:** First Officer Salman Aslam, ED-15716 is 48 years old and had a grand total of 2913 Hrs mostly on A-319 air craft. He has a valid CPL issued to him on 29th October 2004 and he was medically fit to undertake this flight.

3.4 Airfield Weather

3.4.1 In order to obviate any possibility of the weather being a factor in this accident, the Board carried out an in-depth study of the aerodrome weather on the mishap day. The following was revealed:

(a)	Visibility	=	8 Kms
(b)	Wind	=	130°/5-8 Kts
(c)	Clouds	=	Scattered 10000feet
(d)	Present Weather	=	Fair
(e)	Temperature	=	30° C
(f)	Trend for next 2 Hrs	=	No significant trend

3.4.2 The last weather picture and METAR showed that **weather was fit for undertaking this flight** and no significant weather existed, which could be termed as a factor in the causation of this accident.

3.5 On Set of Emergency

3.5.1 The evidence indicated that neither the pilots nor the ground crew observed any abnormality with the *ale* or any of its systems during pre-flight. The taxi/take off from Lahore (AllAP) also remained uneventful. The Pilots stated that after the fourth landing at Walton, at the down-wind position, while coming in for the fifth (full-stop) landing, when the gears were lowered, **the gears down and locked safe light** did not come on. The gears were recycled and the light still did not come on. The light was pressed to test the serviceability of the bulb and the light bulb was found serviceable. It may be noted that in this particular type of *ale* there is only one green light to indicate the locking of all the three gears in down position. However, there are mirrors available to physically see that the gears are down or not and through those mirrors, it was observed that the gears were down and probably locked. In the mean time the green light blinked momentarily and went off again. It was considered that probably the down and locked micro switch was malfunctioning. Therefore the pilots attempted a landing.

3.6 Sequence of Events

- 3.6.1 Nonetheless, with a mind set due to concern about safety of gears, the pilots were cautious during approach and landing, so a smooth touch down in the centre of the runway was ensured. The *a/e* had touched at about 1000 feet down the runway. The landing was made by the student, who being a 1st officer at A-319, was in the habit of applying full brakes. So he went on to full brakes, which was immediately corrected by the IP, who asked the student pilot to let it go and said that they had a long runway and the *a/e* would stop on its own without applying brakes. The *a/e* rolled for about 1400 feet on the centre line. During the roll the pilots observed s_evere vibrations and shaking of complete instrument panel and it was felt as if the wheels were shimmy. After some time at about 40 to 50 MPH of speed the right wing dropped and touched the ground, which was subsequently learnt to be collapsing of the right gear. The collapsing of gear at a low speed prevented a major damage to the *a/c* or injury to the occupants and the *a/c* dragged for about 70 feet on its right wing tip tank and the fusecia/ge and came to rest. Despite minor fuel spillage, the *a/e* did not catch fire.

3.7 Air Crew Emergency Handling

- 3.7.1 In the serious incident under discussion, lapses, if any, on part of the aircrew, in the realm of emergency handling were critically analysed and it was established that during touch and go landings at Walton they had no R/T contact with Walton because Walton R/T was off the air due to load shedding and the aircrew were in contact with Lahore ATC. After the 4th landing when the gears were lowered for the 5th landing, and the gears down and locked safe light did not come on, the aircrew informed Lahore ATC about the problem and took actions as per the check list. The gears were recycled but the light did not come on. They viewed the position of gears through mirrors provided in the cockpit for this purpose and concluded that gears were down. It may be noted that from the visual look through mirror it **can not be ascertained** that the landing **gears are locked** in the down position. As per captain's statement the gears safe light came on when the aircraft was turning finals, and the gear up warning horn did not blow on reduction of throttle. Therefore a decision to attempt a full stop landing was made. Taking

exception to the captain's statement, it was observed that a meticulous follow up of the emergency procedures should have been resorted to, and a manual lowering of the gear should have been attempted. Though the outcome of the occurrence after manual lowering of gears can not be ascertained yet the aircrew can not be absolved of following the prescribed emergency handling procedures.

- 3.7.2 They made a smooth landing and were on the centre line. During landing roll, the trainee applied brakes which resulted in sideways movement of the aircraft. The Captain asked the trainee not to apply brakes and let it slow down. The a/c rolled down the runway on the centre line for about 1400 feet and at about 40-50 MPH of speed Suddenly its right gear collapsed and the a/c dragged on its tip tank and the fuselage and stopped within 70 feet. It was concluded that **the aircrew remained calm and handled the emergency well.**

3.8 Bird Strike

- 3.8.1 The possibility of a bird strike to the aircraft or to the engine, causing damage to the engine or airframe, was also studied in detail and ruled out because there was no evidence to show any broken or damaged structure due to a bird strike, which could obstruct smooth lowering of landing gears. Additionally:
- (a) The pilots or the ATCOs did not observe the presence of the birds on the runway or the adjoining areas.
 - (b) The bird remains were not found on any of the aircraft body parts or in the engine area.
 - (c) The bird shooters and witnesses neither saw any bird activity at the airfield nor did they observe an actual bird strike to the aircraft.
- 3.8.2 On the basis of above evidence, **the possibility of a bird strike to the aircraft was ruled out.**

3.9 Role of Crash & Rescue Party

3.9.1 The mishap aircraft landed normal and rolled for about 1400 feet down the runway and had slowed down before its right, landing gear_ collapsed. Therefore the total skid/ drag area was about 70 feet, within which the a/c just wheel carted to the right side and stopped. Though there was fuel spillage from the right wing tank yet fortunately It did not catch fire. Otherwise also it was not a distant location. Therefore the **Fire Fighting and Rescue Crew promptly reached the site and took all actions as per the checklist.**

3.10 Summary

3.10.1 The aircraft had two technical malfunctions, it's right landing gear indication **"Micro switch"** was intermittent and the torque link of the same gear was dislodged prior to or immediately after the last landing. The aircrew through the indications in the cockpit had reasons to believe that the **"Right, Gear was down and locked"**. During landing roll the right landing gear started to swirl around it's axis, causing further damages and ultimately resulted in its collapse due to dislodged torque link.

4. Observations

- 4.1 The aircrew did not use the emergency procedures (See Appendix 'J') for the extension of landing gears through "Hand Crank" because the gear not down warning horn did not blow.
- 4.2 Director Airworthiness has written a policy letter on implementing of Safety Management System (See appendix 'H') SMS manual has not been prepared.
- 4.3 Maintenance manpower is too short to handle 8 types of aircraft. It does affect the maintenance efficiency and results in maintenance malpractices, such as lack of training/certification, use of improper tools and short cuts.
- 4.4 The Illustrated Parts Catalogue (IPC) for aircraft (310 F-0100) was from December 1965 Change 3 June 1982. It was established through manufacturer that it was updated
- 4.5 The Duty ACTO was not aware of any emergency with aircraft due to Electricity load shedding (the R/T was not operational). Hence ATC/ATS were not in a position to provide any assistance to the aircraft and aircrew in emergency.
- 4.6 Acute shortage of appropriately trained technical personnel in different trades is affecting the quality of maintenance operations.
- 4.7 House keeping needs further improvement.

5. Findings

- 5.1 Aircrew were medically fit and authorised to fly this mission.
- 5.2 Weather was fit to undertake the training flight.
- 5.3 Aircraft was airworthy of flying and there was no defect in the history which could have contributed to the incident.
- 5.4 Aircraft flew for two hrs and made four landings without any problem.
- 5.5 While coming in for the fifth landing when the gears were lowered, the gears down and locked safe light did not illuminate.
- 5.6 The gears were recycled but the light did not come on
- 5.7 A visual check through **"gear position view mirrors"** by the aircrew revealed the gears to be down and probably locked. The audio horn for unsafe gears also did not blow. **Therefore** a decision to make a full stop landing was made.
- 5.8 The aircrew did not attempt the manual lowering of the gears
- 5.9 The "landing gear" down light illuminated while turning finals
- 5.10 The aircraft landed smoothly, rolled for 1400 feet and started to veer to right side with the right dropping and ultimately coming to rest with right gear collapsed.
- 5.11 The right engine propeller, right landing gear linkages, door and panels sustained damages.
- 5.12 The aircrew promptly evacuated and remained unhurt.
- 5.13 Fire and rescue personnel secured the aircraft and fuel spillage.
- 5.14 The landing gears up down position micro switch was found malfunctioning during investigation operational checks.
- 5.15 The "Torque Link" of right landing gear found dislodged. It could have been either prior to landing or after touch down during landing roll.

- 5.16 The dislodging of torque links, hindered the complete down locking of right landing gear, permitted right MLG to swirl around the vertical axis and move inwards; and the abrupt rotation and out of sequence inward movement caused damages to a number of linkages, door and panels.
- 5.17 The torque link can be dislodged if either the washers are not installed or have failed.
- 5.18 It could not be established whether the washers were not installed (undocumented) or had failed due vintage problems.

6. Cause of Occurrence

Aircrew - Non adherence to Emergency Procedures. Aircrew should have lowered the landing gears through "Manual Crank", which might have avoided the occurrence.

7. Finalization

Primary

Human Factor - Avoidable

Contributory

Torque Link Failure - Material Failure- Un-Avoidable

8. SAFETY RECOMMENDATIONS

- 8.1 Lahore (Walton) ATC be provided with a generator / UPS to ensure that essential Air Traffic Control Services are available in the absence of electricity/ Load shedding. (APM Lahore)
- 8.2 Safety Management System Manual be produced by 30 June 2009. Hybrid Aviation be assisted by Controller of Airworthiness (North). (MS Hybrid Aviation)
- 8.3 A Maintenance Programme to improve the maintenance culture at Hybrid Aviation be developed in coordination with Controller of Airworthiness (North) and implemented by 30 June 2009. (MIS. Hybrid Aviation)
- 8.4 Importance of Emergency Procedures be re-emphasized upon aircrew. (GM GA North and South)
- 8.5 M/s. Hybrid Aviation be asked to remove the deficiencies identified by Airworthiness during "Renewal of Maintenance Organisation Approval" inspection. (M/S. Hybrid Aviation)