PSIB

PAKISTAN CIVIL AVIATION AUTHORITY

(SAFETY INVESTIGATION BOARD)

FINAL REPORT

M/S SCHON AIR CESSNA-172D REG # AP-BHT FORCED LANDING AT MALIR CANTT NEAR JIAP KARACHI ON 10th DECEMBER, 2012

INVESTIGATION REPORT

M/S SCHON AIR, CESSNA – 172D AIRCRAFT, REG. # AP-BHT FORCED LANDING AT MALIR CANTT NEAR JIAP KARACHI ON 10th DECEMBER, 2012

Synopsis

On 10th December, 2012, a Cessna-172D aircraft operated by Schon Air was scheduled to undertake a training flight on sector Karachi - Gharo - Karachi, with 02 pilots onboard ie one instructor pilot and the other student pilot. The aircraft took off from Jinnah International Airport (JIAP), Karachi at 1059 UTC and departed to the training area and initiated recovery for JIAP Karachi, as per flight plan. At 1221 UTC on short finals for runway 25R (JIAP Karachi) Captain informed ATC Tower that they were experiencing engine malfunction and losing engine power. The Captain took actions as per aircraft checklist, but the engine power could not be recovered successfully. Meanwhile, the aircraft speed also started to reduce and the aircraft could no longer maintain straight and level flight. The Captain (Instructor Pilot) made a successful forced landing at Malir Cantt on an unprepared track. Both the cockpit crew remained unhurt; however, the aircraft sustained severe structural damages.

Investigation Authority

DG CAA issued notification vide Letter No HQCAA/1901/355/SIB dated 11 December 2012 authorizing Safety & Investigation Board, PCAA to investigate the accident is attached as Appendix "A".

1. Factual Information

1.1.1. **History of the Flight**. The training flight was scheduled on sector Karachi-Gharo-Karachi for aerial work / exercise for the student pilot. The flight took off at 1059UTC and remained in the area till completion of aerial exercises. During the entire area exercise no anomaly related to the engine or any other aircraft related system / sub-system was observed. As per plan the recovery was initiated and at about 3 nm on short finals runway 25R, JIAP Karachi the engine abnormal operation / loss of power was experienced.

1.2. **Injuries to Persons**. No injury resulted to any person onboard or on ground.

1.3. **Damage to Aircraft**. The aircraft and engine suffered structural damages as shown below:

Fig 1: Aircraft Final Full Stop Point

Fig 2: Right Wing Structure severely damaged

Fig 3: Nose Landing Gear broke in air after hitting the concrete wall

Fig 5: Damaged Right Wing and Horizontal Stabilizer

Fig 6: Minor Damage on Left Wing

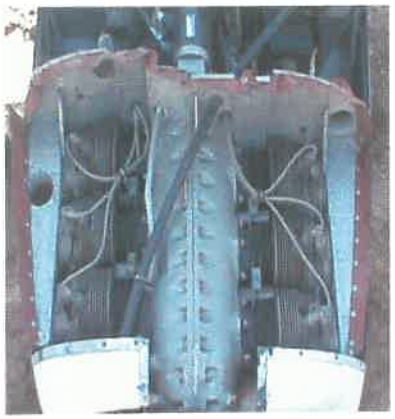


Fig 7: Un-damaged Engine Top Side

Fig 8: Damaged Engine Lower Side, (Oil sump damaged due to breakage of Carburettor)

1.4. **Other damages.** No damage occurred to any other person, property or equipment on ground.

1.5. **Flight Crew Information.** During the mishap training flight on 10th December, 2012 a set of two pilots was onboard the aircraft including one Instructor Pilot and one Student Pilot. The details of cockpit crew are attached as Appendix "B" whereas significant data is as under:

Instructor Pilot

- Date of Birth : 06 April, 1990
- Medical Validity Date : 30 November, 2013
- Flying Experience Total : 491:45 Hrs
- Instructional Flying Experience : 260:00 Hrs
- CPL No : 3040

Student Pilot

- Date of Birth : 16 November, 1993
- Medical Validity Date : 30 September, 2013
- Flying Experience Total : 05:55 Hrs
- SPL No : 3885

(SPL date of issue by GM Licensing CAA, Pakistan is 11th December, 2012)

1.6. **Aircraft information.**

AIRCRAFT	
Aircraft Make	Cessna
Type	172 D
Serial No	17249644
Manufacturing Date	1963

Registration No	AP-BHT
Hours Since New	5311:55
Inducted in Schon Air Fleet	26, November, 2009
ENGINE	
Engine Make	Continental Motors
Type & Model	Piston Engine, O-300-C
Serial No	31918-D-5-C
Date of Overhaul	15 June, 2012
Date of Installation	31 July, 2012
Hours Since New	5398.70
Hours Since Overhaul	282:40
PROPELLER	
Propeller Make	McCauley
Type	Fixed Pitch
Model No.	1C172/EM7651
Serial No	E7231
Date of Overhaul	01-08-2012
Date of Installation	02-08-2012
Hours Since New	Not maintained in logbook by Schon air
Hours Since Overhaul	282:40

1.6.1. The aircraft was fly worthy and it had flown three flights on the day of accident, without experiencing any abnormality in the aircraft or engine performance.

1.6.2. Before the flight, the aircraft was properly serviced with Aviation Gasoline 100 LL fuel up to 42 US Gal, 21 US Gal in each tank.

1.7. **Meteorological information.** The detailed weather data of JIAP Karachi is attached as Appendix "C" however, brief weather data is appended below:

- 1000UTC OPKC 30009 8000 NSC 31/M01 1006.2 29.71 1009.8 29.82 RH 11% NOSIG=
- 1100UTC OPKC 30007 8000 NSC 31/M02 1005.6 29.69 1009.3 29.80 RH 12% NOSIG=
- 1200UTC OPKC 30010 7000 NSC 30/M01 1005.8 29.69 1009.5 29.80 RH 13% NOSIG=
- 1300UTC OPKC 28005 6000 NSC 28/M01 1006.1 29.71 1009.8 29.82 RH 15% NOSIG=

1.8. **Navigation Aids Availability.** Cessna-172D aircraft is equipped with ADF, VOR / DME and ILS equipment for the conduct of its training flight at Schon Air (Pvt) Limited.

1.9. **Communications.** Cessna-172D aircraft is equipped with VHF radio for its two way radio contact with all concerned and relevant agencies during the conduct of flight.

1.10. **Aerodrome information.**

OPKC AD 2.12 RUNWAY PHYSICAL CHARACTERISTICS

Designations RWY NR	True bearing	Dimensions of RWY (M)	Strength (PCN) and surface of RWY and SWY	THR coordinates	THR elevation and highest elevation of TDZ of precision APP RWY
1	2	3	4	5	6
07L	074.29	3200 x 45	64/R/C/X/U CONCRETE Avble for ACFT having Max TKOF Weight Aprox 42200LBS / (19"ON)	245416.90N 0670951.62E	THR 23.50M / 77FT
25R	254.29			245444.55N 0671040.54E	THR 32.40M / 102FT
07R	074.29	3400 x 45	37/R/B/W/T CONCRETE SWY bitumen	245402.16N 0670833.66E	THR 21.52M / 71FT
25L	254.29			245431.75N 0671030.00E	THR 27.25M / 89FT

Designations RWY NR	Slope of RWY/SWY	SWY dimension (M)	CWY dimension (M)	Strip dimension (M)	Obstacle Free Zone
1	2	3	10	11	12
07L	0.2% UP	305 x 45	814	3921 x 305	-
25R		305 x 45	560		
07R	0.166% UP	305 x 45	573x150	4753 x 150	-
25L		305 x 45	453x150		

Remarks: RWY 07R RESA – 180M X 122M

OPKC AD 2.13 DECLARED DISTANCES (M)

Designations RWY NR	TORA	ASDA	TODA	LDA	Remarks
1	2	3	4	5	6
07L	3200	3505	4114	3200	-
25R	3200	3505	3750	3200	
07R	3400	3705	4270	3400	-
25L	3400	3701	3853	3403	

OPKC AD 2.14 APPROACH AND RUNWAY LIGHTS

Designations RWY NR	APCH LGT type LEN INTST	THR LGT colour WBAR	VASIS (MEH) PAPI	TDZM LGT LEN	RWY Centre line LGT Length, spacing, colour, INTST	RWY EDGE line LGT Length, spacing, colour, INTST	RWY End LGT spacing colour WBAR	SWY LGT LEN (M) colour	Remarks
1	2	3	4	5	6	7	8	9	10
07L	SALS LIH	GREEN	PAPI Left 3°	-	-	3200 M, 60 M,	RED	-	Strobe LGT
25R	PALS LIH	GREEN	PAPI Left 3°	-	-	WHITE LIH	RED	-	-
07R	SALS LIH 300 M	GREEN	PAPI Both sides 3.91°	-	3402M 30 M white LIH	3400 M, 60 M, white LIH	RED	-	-
25L	PALS LIH 900M	GREEN	PAPI Both sides 3.96°	900 M	Last 900 M alternate white/red	Last 600 M yellow	RED	-	Flashers

OPKC AD 2.18 ATS COMMUNICATION FACILITIES

Service designation	Call sign	Frequency	Hours of operation	Remarks
TWR	KARACHI Tower	118.3 MHZ	H24	Primary
		118.6 MHZ	H24	Secondary
		121.5 MHZ	H24	Emergency
APRON	Karachi Ground	121.6 MHZ	H24	Primary
		118.4 MHZ	H24	Secondary
		121.8 MHZ	H24	Vehicle
		123.0 MHZ	H24	
ATIS	ATIS	126.7 MHZ	H24	
APP	Karachi APP	125.5 MHZ	H24	Primary
	Karachi APP	121.3 MHZ	H24	Secondary
	Karachi APP	121.5 MHZ	H24	Emergency
SS	Radio	330 KHZ	HX	0130-1900 HR
SS	Pakistan	1450 KHZ	HX	Variable SKED

OPKC AD 2.19 RADIO NAVIGATION AND LANDING AIDS

Type of aid. CAT of ILS (VAR VOR/ILS)	ID	Frequency	Hours of operation	Site of transmitting antenna coordinates	Elevation of DME transmitting antenna	Remarks
1	2	3	4	5	6	7
GP 25R	Dots/Dashes	334.4 MHZ	H24	245448.11N 0671229.32E	-	-
LZ 25R	IKC	110.1MHZ	H24	245413.64N 0670537.69E	-	-
ILS CAT I (1°E/1995)						
LOM	KC	235 KHZ	H24	245547.74N 0671849.69E	-	3.8 NM FM THR
MM		75 MHZ	H24	245453.60N 0671107.99E	-	0.57 NM FM THR
GP-TDME 25L	Dots-Dashes	333.2 MHZ CH 34X	H24	245432.35N 0671213.99E	-	2.95° RDH 72 FT
LZ25L ILS CAT I (1°E/1995)	IQA	109.7 MHZ	H24	245359.69N 0670950.94E	-	-
NDB	KC	271 KHZ	H24	245553.80N 0670536.29E		Coverage 50NM
VOR / DME	KC	112.1 MHZ CH 56X	H24	245437.72N 0671235.94E	37.83M	Coverage 30DME Radial 30° un-reliable

1.11. **Flight Recorders.** Cessna-172D is not equipped with Flight Data Recorder (FDR) and Cockpit Voice Recorder (CVR).

1.12. **Wreckage and impact information.**

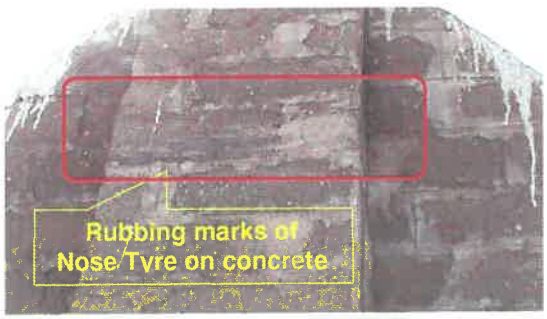
1.12.1. Wreckage site was located in the Malir Cantonment about 3 km short of runway 25R, JIAP Karachi. The area was immediately cordoned off. It was ensured that the site remain undisturbed to keep all evidences available till arrival of investigation team. Upon arrival of the investigation team, about one hour after the occurrence, the

aircraft was handed over to the investigation team. Following were the salient observations at the wreckage site:

1.12.1.1. Wreckage was confined to an area of about 170x40 sq ft.

1.12.1.2. The aircraft was mainly intact despite severe structural damage to its right wing, horizontal and vertical stabilizers.

1.12.1.3. The nose landing gear had broken and was lying 140 ft behind the aircraft. It broke due to impacting with the concrete wall.



1.12.1.4. Carburettor of the engine broke off from its housing after the engine rubbed against the ground due to nose landing gear breakage. It was found lying near left wing about 4 ft from the engine.

1.12.1.5. Some other minor parts of the aircraft were found behind the aircraft final resting point, i.e, left wing tip 60 ft, left navigation light glass cover 35 ft and left wing tip 38 ft.

1.13. **Aircrew Medical Examination.** Following the occurrence on 10th December, 2012 at Malir Cantonment Karachi, the blood and urine samples of both the cockpit crew were collected which did not reveal any abnormality. The medical test results of cockpit crew blood and urine samples are attached as Appendix "D".

1.14. **Fire**. Although fire did not occur on ground, however, Fire Crash Tender was operated on the aircraft after the aircrew had safely disembarked on their own. This was done as a precautionary measure to prevent fire which might occur due to the fuel vapours accumulating in the vicinity of aircraft from the fuel that was leaking from the damaged wing fuel tanks.

1.15. **ATC Tape Extracts.** ATC Tape extracts were retrieved for detailed analysis. The ATC tape extracts are attached as Appendix "E".

1.16. **Survival aspects**. Both the instructor and student pilots were lucky to have survived unhurt from such a serious incident.

1.17. **Tests and research**. After removal of the wreckage from accident site, detailed visual examination was performed followed by strip examination of the relevant structural, airframe and engine parts/systems/sub-systems. Functional testing of

some components was also carried out. Based on these examinations and tests, engine controls (including Throttle Control Cable, Mixture Control Cable and their respective bolt and nut assemblies) were taken to **Failure Analysis Centre (FAC), NUST, Islamabad** for Failure Mode Analysis to determine their pre and post ground impact status through scientific methods. Similarly, fuel and oil samples taken from the aircraft after the accident and from the serviceable stores held at Schon Air which were used for servicing of the aircraft before flight, were tested at **Intertek Pakistan (Pvt.) Ltd, Karachi.**

1.18. **Useful and Effective Investigation Techniques.** Non-destructive inspection methods including visual inspection, Scanning Electronic Microscopy (SEM) and Energy Dispersive Spectroscopy (EDS) were utilized to conduct onsite and subsequent examinations on the broken or damaged parts to ascertain the type of fracture/damage, the forces causing that fracture/damage and most importantly whether it was pre or post occurrence fracture.

Analyses

2.1. Operational Analysis

2.1.1. The training flight was duly authorized by the Schon Air Management on the day of occurrence.

2.1.2. The weather was fit to undertake the training flight on the day of occurrence.

2.1.3. It was observed that the Student Pilot had flown 05:55 hrs at Schon Air including the mishap training flight on 10th December, 2012 prior to the issuance of his SPL No. 3885 on 11th December, 2012 by CAA Pakistan. As per CAA Pakistan the Student Pilot is authorized to fly a maximum of three hours air experience (Refer Appendix "F").

2.1.4. Both the cockpit crew were medically fit to undertake the said training flight on the day of occurrence.

2.1.5. While going through the last 72 hours activity of the individual cockpit crew, it was observed that they were not exposed to unnecessary unrest / fatigue prior to the conduct of mishap training flight and no violation of FDTL was observed.

2.1.6. The post occurrence blood and urine samples of both cockpit crew did not reveal any abnormality.

2.1.7. The Instructor Pilot was pilot flying at the time of occurrence (around 3 nm short of runway 25R, JIAP Karachi).

2.1.8. At around 3 nm while flying at 900 ft AGL when the power was retarded and rpm adjusted from 2300 to 2000, Captain felt sudden loss of engine power which was cross verified by cockpit instrument indications and rpm was observed at 1000.

2.1.9. At that particular time (rpm 1000), captain did not monitor the oil temperature and pressure.

2.1.10. After confirmation of loss of engine power, Captain took the correct recommended actions as per aircraft checklist and reduced speed to 75 mph.

2.1.11. All the actions by Captain to recover the aircraft engine performance / operation were unsuccessful.

2.1.12. Captain analyzed the abnormal situation and decided to force land the aircraft in Malir Cantt area as he observed the aircraft losing altitude and speed making it impossible to reach the JIAP runway 25R in glide.

2.1.13. Captain started to turn the aircraft left for the selection of suitable forced landing field / area as he saw the high tension wires between his aircraft and JIAP runway 25R.

2.1.14. After turning left through 90^0 Captain picked up the unprepared track and started to make approach for forced landing.

2.1.15. Captain was turning with shallow angle of bank to get in line with the unprepared track.

2.1.16. During this time the speed of aircraft continued to drop and stall warning was heard just before touchdown.

2.1.17. Captain continued the approach with shallow angle of bank till almost round / flare out height.

2.1.18. While the aircraft was still flying in air, the nose wheel impacted with the side surface of concrete wall in shallow angle of bank at a height of around 10 to 12 ft.

2.1.19. As a result of this impact, the nose wheel got dislodged and flew away from aircraft structure.

2.1.20. By this time, the right horizontal stabilizer came in contact with the top flat surface of the same concrete wall and got completely smashed / destroyed.

2.1.21. After this impact, the aircraft flew at around 7 to 8 ft height in almost wings level state before its right wing impacted with another concrete wall.

2.1.22. The aircraft right wing impacted with the concrete wall and resulted in severe damage to the right wing.

2.1.23. As a result of this impact, the right wing fuel tank got ruptured and fuel started to leak from the fuel tank.

2.1.24. After the impact of right wing with the concrete wall, the aircraft came to very low speeds and it just sat on the ground. The observed aircraft dragging marks were not more than 3 to 4 ft on ground.

2.1.25. The aircraft after forced landing was immediately cordoned off.

2.1.26. The fire crash tender reached the occurrence site in a very short time.

2.1.27. As the fuel could be seen leaking out of the right wing tank, the fire crash tender was used as a precautionary measure to avert any post occurrence ground fire.

2.1.28. The leaking fuel was collected by placing buckets / drums under the right wing root area.

2.1.29. The aircraft was observed resting on its nose area (due to flown off nose landing gear) and main wheels. The details of damages are given in technical part of the investigation.

2.1.30. During the entire abnormal situation handling, it was observed that the Captain remained cool and calm while taking all desired / recommended actions and decisions in an extremely professional manner to ensure a safe and successful forced landing on unprepared track / ground surface.

2.1.31. Captain carried out all the recommended actions for making the cockpit safe before carrying out emergency evacuation and guided student pilot to evacuate the aircraft.

2.2. Technical Analysis

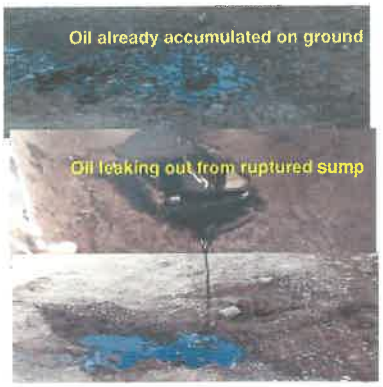
On-site Wreckage Examination

2.2.1. **Fuel.** Fuel was found splashed on ground and continuously leaking out from the right wing tank due to rupturing of the wing structure. As there was no damage to the left wing, therefore, no fuel leakage was observed from the left wing tank. Later on, when its drain was opened, sufficient fuel was found available in the tank. About 25 ltrs of fuel was collected from both the tanks.

Fuel being collected from Left Wing Tank

Fuel being collected from Right Wing Tank

2.2.2. **Engine Oil.** When the aircraft nose was lifted up, oil was found splashed on ground and also leaking from the ruptured oil sump. It indicated that sufficient quantity of oil was available in the engine oil system prior to the mishap. Oil sample was collected for subsequent lab test.



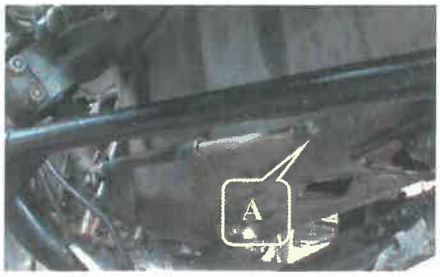
2.2.3. **Engine.** Engine cover panel was removed for examination. The engine, its surroundings and associated equipment were in good condition and apparently did not indicate any pre-existent anomaly. The damages observed were generally consequential in nature due to forced landing on the unprepared track and rubbing against the ground as the nose wheel had already separated from the aircraft after impacting the concrete wall.

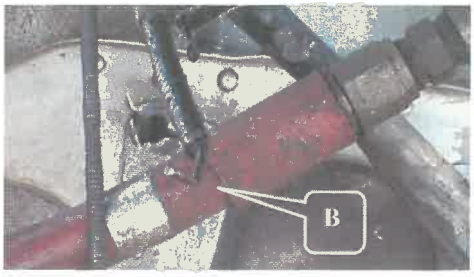
Engine Top View

Engine Side View

2.2.4. **Carburettor.** Carburettor of the engine was found dislodged from its housing and lying on left side of the cockpit underneath the left wing. It was badly damaged due to rubbing against the ground. Throttle control cable linkage indicated on the figure as '**A**' was found broken; whereas, no trace of mixture control cable was found on the installation bolt and nut, indicated on the figure as '**B**'. There was barely any damage to the installation nut and bolt which can be clearly seen in the close up view of '**B**'. Even the bolt-hole through which the mixture control cable passes did not show any signs of damage. The carburettor was preserved for subsequent examination.

2.2.5. **Throttle and Mixture Control Cables.** Both these cables were found hanging alongside the engine. Throttle control cable linkage '**A**' was found broken; whereas, mixture control cable '**B**' was apparently not broken. However, the mixture control cable indicated two minor bends at its extreme end.





2.2.6. **Fuel Samples.** Fuel samples were taken from left and right wing tanks as well as from the source (barrels used for refuelling). These were tested against the standard specifications of AV gasoline 100 LL. The test results attached as Appendix "G" did not show any abnormality.

2.2.7. **Oil Samples.** Oil samples were taken from the engine oil sump and were tested in comparison with the oil sample (Aero Shell Oil W 15W-50 used for the engine) taken from the new oil can. The test results attached as Appendix "H" did not show any abnormality.

2.2.8. **Failure Mode Analysis.** Failure Mode Analysis was conducted on Throttle Control Cable, Mixture Control Cable and holding nut and bolt assembly of Mixture Control Cable at **Failure Analysis Centre (FAC), NUST, Islamabad.** The detailed analysis reports are attached as Appendix "J". According to these analyses, it has been conclusively established that the mixture control cable slid out of the bolt-hole during service. This cable neither broke from any place nor did its extreme end show any signs of scratches. Similarly, the bolt-hole through which this cable passes, securing nut and washers also do not bear any evidence of sudden impact or pulling force. Hence, it can be concluded that the mixture control cable gave in during routine service most probably due to inadequate security at the time of its installation. Contrary to this, the throttle control cable broke due to ductile overload at the time of carburettor breakage as a result of its rubbing against the ground.

2.2.9. **Strip Examination of Aircraft and Engine**

2.2.9.1. The Engine Power Loss can be attributable to a number of factors, which are:

2.2.9.1.1. Fuel starvation

2.2.9.1.2. Oil starvation

2.2.9.1.3. Failure of Engine's internal parts

2.2.9.1.4. Failure of electrical supply to spark plugs

2.2.9.1.5. Failure of mechanical linkages of throttle or mixture control cable

2.2.9.2. All possible causes of engine power loss were thoroughly investigated by stripping of aircraft and engine components in the maintenance hangar of M/s Schon Air. These are discussed in the proceeding paragraphs.

2.2.9.3. **Fuel Starvation.** Fuel starvation can be caused by :

2.2.9.3.1. Insufficient fuel in the aircraft storage tanks due to inadequate servicing before flight.

2.2.9.3.2. Loss of fuel in air due to either rupturing of fuel tanks or fuel supply lines from fuel tanks to the carburettor.

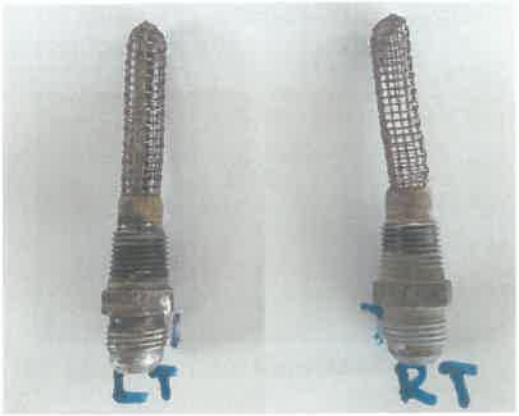
2.2.9.3.3. Discontinuity of fuel supply to the carburettor and the engine due to contamination in fuel or clogging of fuel filters.

2.2.9.3.4. No evidence related to the above mentioned possible causes was found. Following photos depict the examination details:

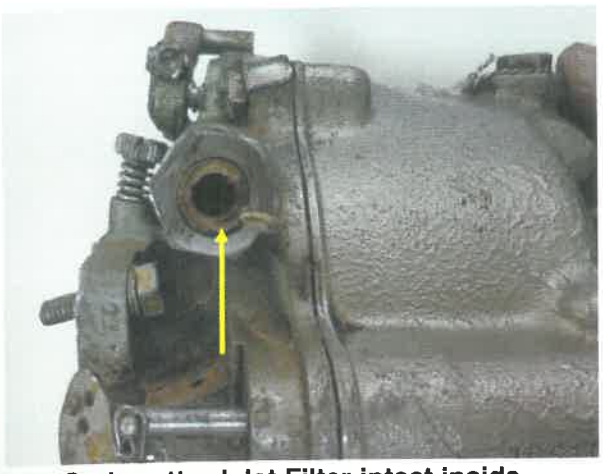
Properly Secured and un-damaged Left Wing Fuel Tank

No Anomaly observed in the Cavity of Left Wing Fuel Tank

Undamaged fuel pipes and elbow union fairings

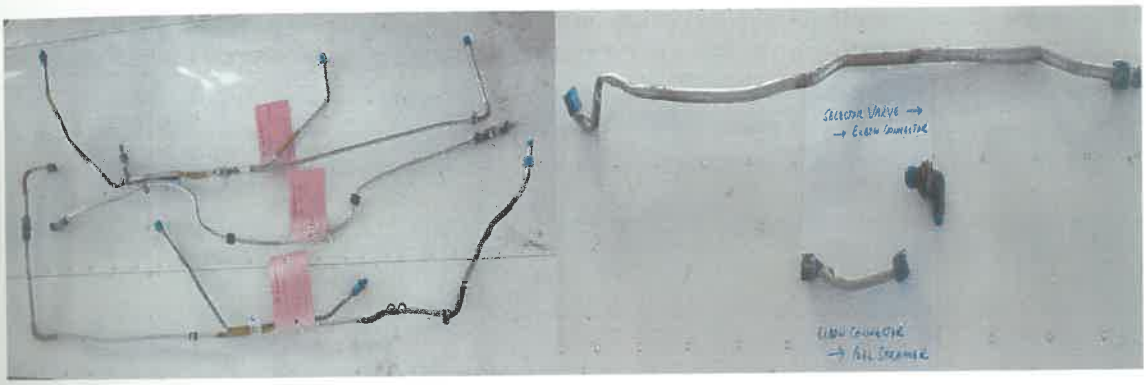


Screen Filters of Left and Right Wing Fuel Tanks clear of clogging or contamination



Carburettor Inlet Filter intact inside

Carburettor Inlet Filter
Undamaged and Unclogged



Pipes of fuel supply lines from Wing Tank to Carburetor

2.2.9.4. **Oil Starvation.** As already mentioned above, quite a good quantity of oil was found splashed on ground under the engine at the crash site. Later on, once the oil filter was removed in the maintenance hangar, large quantity of oil was found available in the oil sump which was collected for subsequent lab test. Similarly, the filter was also found not clogged and in a satisfactory condition. Therefore, the possibility of oil starvation due to insufficient oil quantity, leakage in oil system or clogging of oil filter was not a likely cause. See figures below.

Undamaged Oil Filter Housing

Oil being collected from Oil Sump

Undamaged and Unclogged Oil Filter

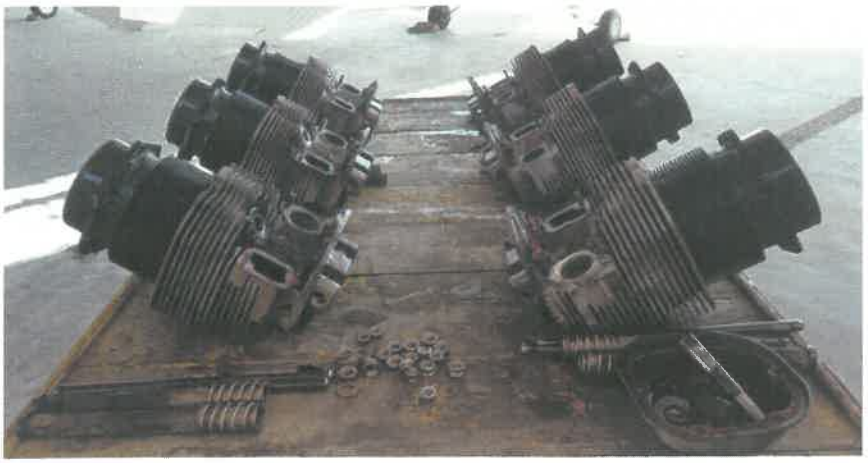
2.2.9.5. **Failure of Engine's Internal Parts.** Strip examination of the engine was done till the connecting rods level. The examination of all six cylinders and their associated hardware did not point to any abnormality. All these parts were found intact, well lubricated and without any distortion or damage signs.

Left Hand Side 03 Cylinders

Right Hand Side 03 Cylinders

Left Hand Side 03 Pistons

Right Hand Side 03 Pistons

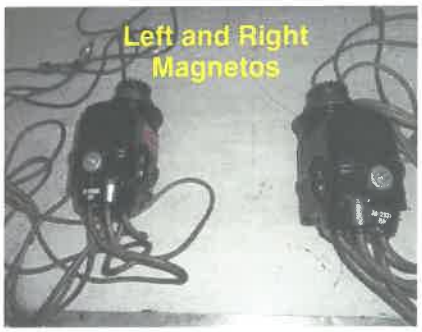


Undamaged 06 Cylinders along with their associated Parts

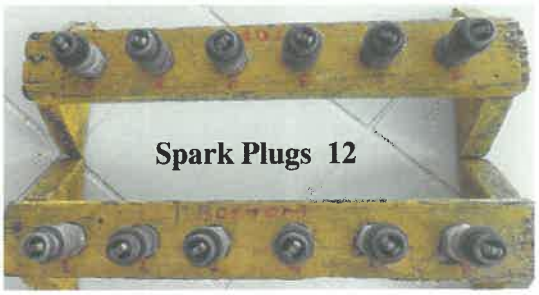
No scoring, scratches or overheating signs observed on inner side of 06 Cylinders along with their associated Parts

2.2.9.6. Examination of pistons, cylinders, connecting rods and associated parts indicated that there was no mechanical damage to the engine's internal parts and engine operation was unhindered.

2.2.9.7. **Failure of Electrical Supply to Spark Plugs.** Critical examination of all electrical leads and connections did not indicate any discontinuity. Both magnetos were removed and inspected for any damage signs. Physical condition of both the magnetos and their leads was satisfactory. Operation of magnetos could not be checked due to non-availability of testers. However, with perfectly normal condition of both magnetos and their electrical leads, the possibility of both the magnetos breakdown at the same time was extremely rare.



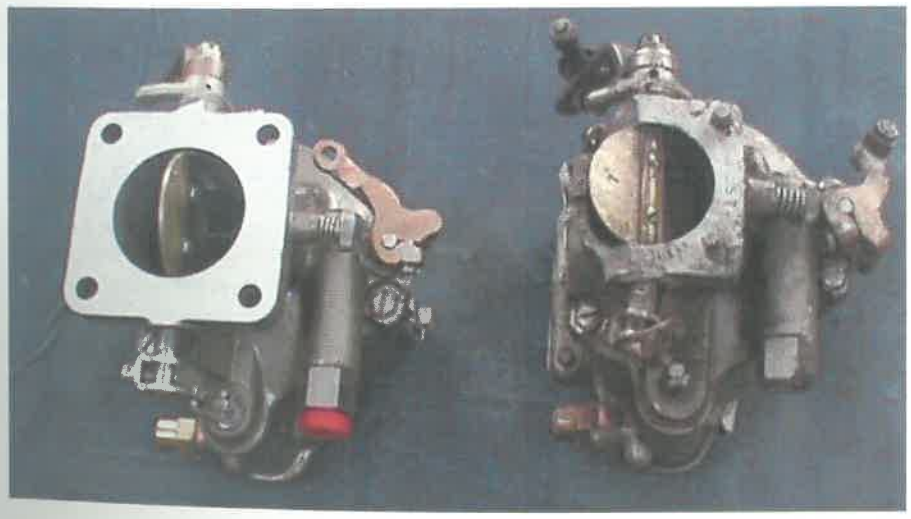
2.2.9.8. Similarly, all 12 spark plugs were removed, inspected and tested on the tester. Their physical condition was excellent and their operation was also satisfactory.

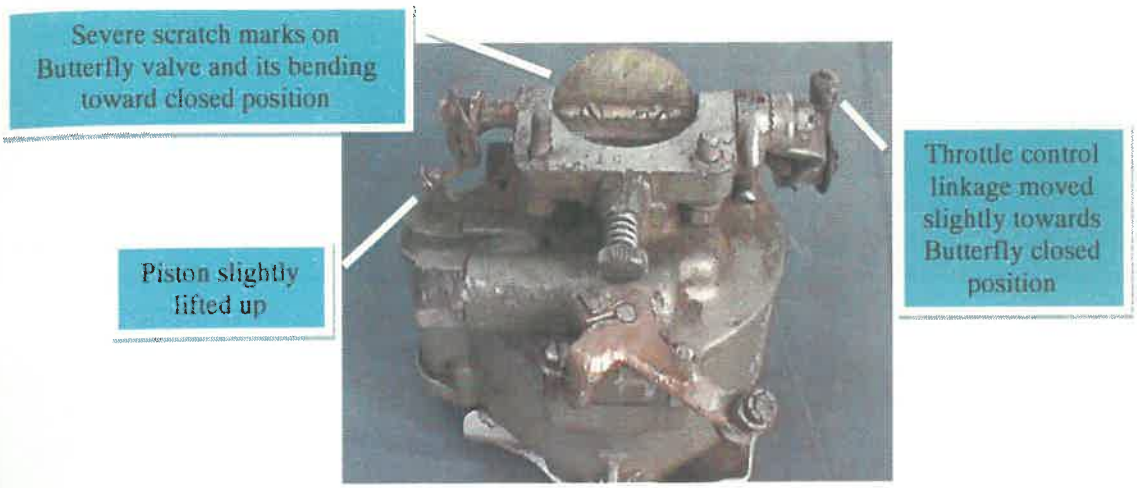


2.2.9.9. Both the magnetos independently supply electric current to one of the two spark plugs of each cylinder. With extremely rare possibility of their malfunctioning simultaneously and satisfactory condition and operation of all spark plugs, it was concluded that at least one of the two spark plugs of each cylinder was being provided electric current throughout the flight. Hence, there was no possibility of engine power loss due to discontinuity in the electrical supply to spark plugs.

2.2.9.10. **Failure of Throttle or Mixture Control Cable.** Throttle and air-fuel mixture control linkages on the carburettor are linked to the cockpit through cables. These provide access to the pilots for adjustment of throttle and mixture as per the requirement. As the carburettor had been broken due to rubbing against ground after breakage of nose landing gear during forced landing, therefore, both these linkages were found disconnected on the carburettor. Detailed examination of carburettor and its comparison with a serviceable one indicated that :

2.2.9.10.1. Upper half of Butterfly Valve of the Carburettor was slightly bent and had severe scratch marks in the direction of Butterfly Valve closed position.

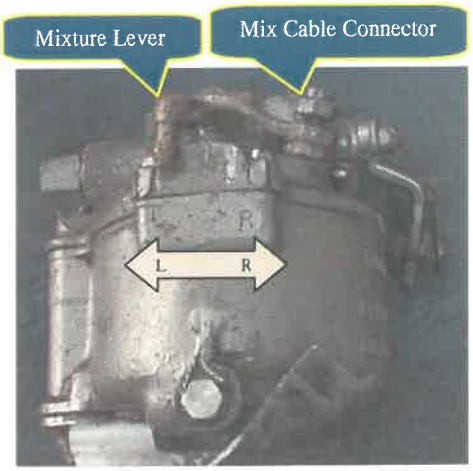




A serviceable carburettor, showing state of throttle lever and piston when the butterfly valve is at fully closed position

2.2.9.11. From the comparison it became evident that Butterfly valve was in "Fully Open" position (throttle full open) at the time of impact. Due to rubbing against ground its upper half suffered severe scratches and was bent in the direction of closed position, but the lower half remained in open position.

2.2.9.12. Air Fuel Mixture Control Lever on the carburettor has two positions, marked as "**L**" and "**R**" which stand for 'Lean' and 'Rich' respectively. It was found moving freely between L & R and, hence, was non-conclusive of its position at the time of impact.



2.2.9.13. Mixture control cable was not found in its connector on the carburettor. On the contrary, throttle control cable was found broken and its broken part was still securely held with its connector. Inspection of both these cables held with the aircraft also indicated that throttle control cable end had been broken, but the mixture control cable was apparently complete and had not been broken by any external force, like impact with or rubbing against ground.

2.2.9.14. Both the throttle and mixture control cables and carburettor were taken to **Failure Analysis Center (FAC)**, NUST, Islamabad for failure mode analyses. After detailed examination and analyses, it was conclusively established that the Mixture Control Cable was pulled out of its connecting bolt-hole during routine service. The report of FAC is placed as Appendix "J". Salient points of the report are :

2.2.9.14.1. *The mixture cable wire is made of HSLA steel.*

2.2.9.14.2. *The cable did not fail in service or due to overload caused by impact on ground.*

2.2.9.14.3. *Longitudinal marks along the surface of the cable indicated that it was not held securely in place and it got dislodged from the original point of installation.*

2.2.9.14.4. *The bent angle on the cable was approximately 20 and 30 degrees at the two bends, which indicates that it was either not bent fully or got straightened due to higher ductility of the material.*

2.2.9.14.5. *The evidence present on the cable suggests that it got dislodged from the carburettor under a pulling force. In order to conclude the failure analysis of this mixture cable, detailed analysis of the associated nut, bolt and washers of the carburettor was conducted.*

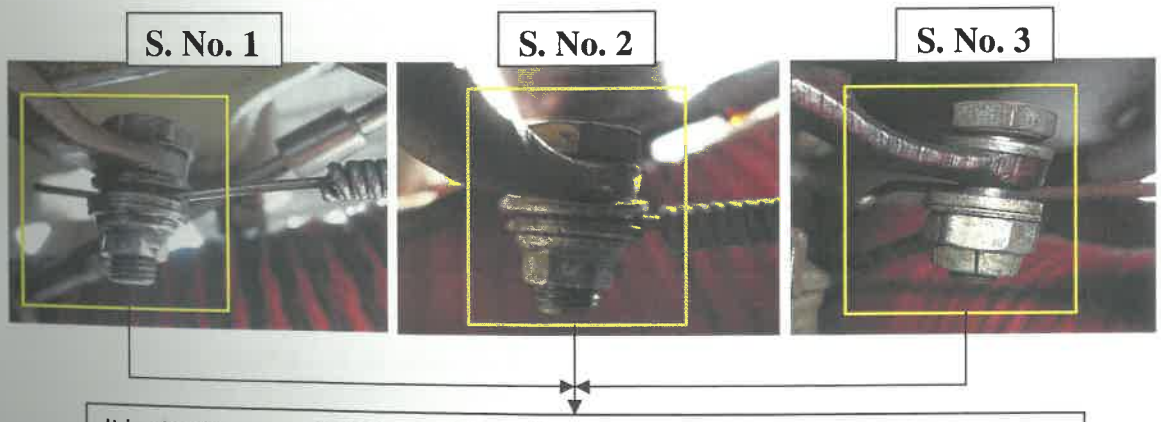
2.2.9.14.6. *It was concluded that the cable got dislodged from the carburettor under a constant / regular pulling force during routine operation.*

2.2.10. During the course of investigation, to have an understanding about the standard practice of Mixture Control Cable installation and security, inspection of three aircraft parked in the Schon Maintenance Hangar was carried out. Although two of the three aircraft inspected were not fly worthy and it was informed by the engineers of Schon Air that these aircraft would be subjected to maintenance work as per the relevant manuals before offering to Airworthiness Directorate for seeking Certificate of Airworthiness ('C' of 'A'); however, the status of mixture control cable was still considered to be a reasonably reliable indicator of the maintenance practices. Additionally, one of those three aircraft was certainly serviceable and in operational service. Following table provides the information regarding the status of mixture control cables on those three aircraft.

Table : 1

S No	Aircraft Reg No	Aircraft status, Serviceable Yes (Y) / No (N)	Additional mixture cable length after passing thru the bolt-hole of connector (mm)	Number of washers on the bolt	Position of washers on the bolt
1	AP-BJG	Y	15 (without any bend at extreme end)	02	01 with Nut, 01 with Lever
2	N54213	N	0.0	02	-----//-----
3	N98662	N	15 (02 mm bent at extreme end for security)	02	Both washers with Nut, Lever side without washer
As per Cessna Model 100 series Service Manual (1963 through 1968), Page 12-23, Para 12-62, cable after passing through the bolt-hole and secured by tightening the nut should be bend 90 degrees to provide additional security against disengagement during routine service.					

Table : 1 is further pictorially elaborated below:



It is clearly evident from these pictures that:

- Additional Cable length after passing through the bolt-hole is not maintained up to a standard scale.
- Bending of cable 90^0 after passing through the bolt-hole for additional security against dislodgment is not ensured.
- Use of washers on either side of the cable is not ensured and is not even standard on all aircraft.
- Nuts used on the bolt for tightening the cable are not of same type and design.

2.2.11. **Cause Factors**

2.2.11.1. **Non-conformance of OEM Recommendations.**

2.2.11.1.1. **Re-use of Life Expired Parts.** The engine controls including mixture and throttle along with their associated hardware (nuts, bolts, washers, etc used for connecting engine controls with the carburettor) were required to be changed at Engine TBO. However, none of these parts were changed and old parts whose life could also not be ascertained from the records provided to the investigation team were utilized during re-installation of engine after overhaul by Schon Air maintenance personnel which is a violation of Cessna 100 series service manual (1963 through 1968), Cessna –Established replacement time limits for engine mixture control, page 2-26, Rev-1, (Aug-2003) attached as Appendix "K". Moreover, list of life components provided by Schon Air to the Office of Controller of Airworthiness (South) at the time of last "C of A" Renewal of the aircraft also did not include these engine controls as life components (Refer Appendix "L"). Office of Controller of Airworthiness (South) also did not monitor and cross verify the Manufacturer / Airworthiness Directorate requirements.

2.2.11.1.2. **Using Nut & Bolt of Obsolete Design on Mixture Control.** Nut & Bolt of obsolete design and specifications were found installed on the mixture control attachment with the carburettor. Bolt Part No. AN4-6A and Nut Part No. AN-310-6 was found installed; whereas, the OEM had recommended, vide Service Information Letter (SIL) No. SE 79-6, dated 16th April, 1979 (Refer Appendix "M"), use of a predrilled AN Bolt Part No. AN3-6, Castellated Nut Part No. AN 310 and a cotter pin on the engine controls attachments for throttle, mixture and propeller control cable ends. This improved type attachment was required to be incorporated on all earlier aircraft at the next 100 hours or annual inspection. The SIL was applicable on the mishap aircraft, Cessna Reg # AP-BHT, but in violation of CAA Pakistan airworthiness notice (AWNOT-015-AWAA-3.3, Para D8.4, attached as Appendix "N"), Schon Air did not take any action on this SIL which had a direct bearing on the safe aircraft flight operations. Same was not checked and ensured by CAA Pakistan during any of the 'C of A' inspections.

2.2.11.1.3. **Improper Procedure of Installation and Security of Mixture Control.** As per the OEM recommended procedure (Refer Appendix "O"), the mixture control cable after installation is required to be bent 90° for providing additional security against dislodgment. Same was not done at the time of its installation and engine's controls rigging. It is also neither covered in the independent duplicate inspection checks nor in the checklist of Airworthiness Inspector.

2.2.11.2. **Violation of Civil Aviation Rules (CAR's 1994)**

2.2.11.2.1. **Action on Service Information Letters (SIL's).** Schon Air had no record of applicable Service Information Letters (SIL's) and thus was not taking any action on the OEM recommendations mandated by airworthiness notice, (Refer AWNOT-015-AWAA-3.3, Para D8.4, attached as Appendix "N"). However, Airworthiness Directorate, CAA Pakistan was not ensuring the implementation of said requirement. Checklist, appendix 'A' to SOP-003-AWRG-2.1 (attached as Appendix "P"), used by the AW inspectors for inspection before initial issue / validation of "C of A" does not require maintenance organization to provide record of applicable service letters

(SIL's) and the action taken on OEM recommendations. Moreover, the checklist for "C of A" renewal inspection attached as Appendix "Q" does not even cover checking of SB's, AD's and SIL's records. Consequently, same was not checked by the AW inspectors during any of the inspections for initial issue / validation / renewal of C of A, resulting into non-compliance of the OEM recommended SIL's by Schon Air since induction of the mishap aircraft. Hence, safety of the aircraft flight operations was compromised which has a direct bearing on the cause of this accident.

2.2.11.2.2. **Non-availability of Maintenance Manual Approved by CAA Pakistan.** Rule 27 (a) of CAR's 1994 requires that an aircraft registered in Pakistan shall not fly unless it is being maintained, serviced and inspected in accordance with the Maintenance Manual approved by DG CAA Pakistan (Refer Appendix "R"). Similarly, Rule 30 of CAR's 1994 (Refer Appendix "S") requires that all operators shall provide Maintenance Manual approved by DG CAA Pakistan for guidance of the maintenance personnel performing maintenance on their aircraft. However, maintenance manual approved by CAA Pakistan was neither held by Schon Air, nor was it issued by Airworthiness Directorate till finalization and compilation of this report. It was learnt during discussions with the relevant officials that the requirement of the maintenance manual approved by DG CAA Pakistan was not being given due importance, and maintenance by an approved maintenance organization according to service manual provided by OEM was considered sufficient. That is why; Schon Air was also allowed to fly the mishap aircraft without its maintenance as per the approved maintenance manual. This understanding, however, does not seem to be derived from the clearly defined rules and regulations of CAA Pakistan. For example, CAR's Rule 30 lists down the contents of Maintenance Manual, some of which are not covered in the service manual provided by the OEM and hence, cannot be considered sufficient to satisfy the requirements of Rule 30. Then, Approval of Maintenance Program is covered in SOP -013-AWRG-2.1 dated 11th June, 2011 issued by Airworthiness Directorate on behalf of DG CAA Pakistan (Refer Appendix "T"). Para A2. of this SOP clearly states that Rule 27 of CAR's 1994 requires that an aircraft registered in Pakistan shall be maintained under Maintenance Schedule (Maintenance Program) recommended by Manufacturer and approved by CAA Pakistan. Similarly, Checklist, appendix 'A' to SOP-003-AWRG-2.1 (Refer Appendix "P"), used by the AW inspectors for inspection before initial issue / validation of "C of A" requires maintenance organization to possess approved maintenance schedule (English) issued by CAA Pakistan. From the aforesaid factual examples of CAR's rules and SOP's of CAA Pakistan Airworthiness Directorate, it can be explicitly deduced that :

2.2.11.2.2.1. *No maintenance organization can undertake maintenance of an aircraft on the registry of Pakistan unless it possesses a maintenance manual approved by DG CAA Pakistan for that aircraft.*

2.2.11.2.2.2. *No Air Operator's Certificate (AOC) can be issued to an organization unless it possesses and provides for guidance of maintenance personnel performing maintenance on its aircraft a maintenance manual approved by DG CAA Pakistan for that aircraft.*

2.2.11.2.2.3. *No "C of A" can be issued in respect of any aircraft unless the organization proves that maintenance on that aircraft has been carried out in accordance with a maintenance manual approved by DG CAA Pakistan for that aircraft.*

2.2.12. **Observations**

2.2.12.1. **Schon Air.** Through interactions with Schon Air maintenance personnel and review of various records, there were some observations regarding record keeping in the maintenance control and non-observance of meeting maintenance requirements. Details of which are attached as Appendix "U".

2.2.12.2. **CAA Pakistan.**

2.2.12.2.1. The first "C of A" for the aircraft was issued by Director Airworthiness on 11th Janurary, 2010 and validated by Airworthiness Surveyor from 10th February, 2010 to 09th February, 2011. It is being done in this manner whereby, the Director signs the "C of A" before confirmation from the field office regarding completion of all mandatory requirements and sends it to the field office without the validity period annotated on it, as per SOP-003-AWRG-2.1, para D4.3 (Refer Appendix "X"). Field office is then required to annotate the validity period after having been satisfied on the mandatory requirements. It is considered against the usual norm of hierarchical authorization of a sensitive nature activity.

2.2.12.2.2. Airworthiness Surveyor signed and validated the period on "C of A" of initial issue without having the powers to do so (Refer Appendix "Y") using the stamp of Senior Airworthiness Surveyor. Refer delegation of powers of CAR's 1994 to Airworthiness officers by DG CAA in the year 2000; whereby, at least Controller Airworthiness is authorized to sign on the initial issue / validation of "C of A". Refer Appendix "Z".

2.2.12.2.3. Airworthiness Surveyor used the checklist of "C of A" renewal instead of the checklist for initial issue / validation of "C of A" while meeting mandatory airworthiness requirements for initial issue / validation of "C of A". Refer Appendix "Z".

2.2.12.2.4. The irregularities observed in initial issue / validation of "C of A" would have been curtailed if the usual norm of hierarchical authorization of sensitive nature activities had been followed. Meaning thereby that, the field office after satisfying the mandatory airworthiness requirements should then submit the relevant checklist duly completed along with the essential documents, etc and recommend the issuance of "C of A" to Director Airworthiness.

2. Findings

2.1. Operational

2.1.1. The training flight was duly authorized by the Schon Air Management on the day of occurrence.

2.1.2. The weather was fit to undertake the training flight on the day of occurrence.

2.1.3. It was observed that the Student Pilot had flown 05:55 hrs instead of 3:00 hrs at Schon Air including the mishap training flight on 10th December, 2012 prior to the

issuance of his SPL No. 3885 on 11th December, 2012 by GM Licensing CAA Pakistan.

2.1.4. Both the cockpit crew were medically fit to undertake the said training flight on the day of occurrence.

2.1.5. While going through the last 72 hours activity of the individual cockpit crew, it was observed that they were not exposed to unnecessary unrest / fatigue prior to the conduct of mishap training flight and no violation of FDTL was observed.

2.1.6. The post occurrence blood and urine samples of both cockpit crew did not reveal any abnormality.

2.1.7. The Instructor Pilot was pilot flying and at around 3 nm from runway 25R while flying at 900 ft AGL when the power was retarded and rpm adjusted from 2300 to 2000, he observed sudden loss of engine power and rpm was at 1000 but did not monitor the oil temperature and pressure.

2.1.8. After confirmation of loss of engine power, Instructor Pilot took the correct recommended actions as per aircraft checklist and reduced speed to 75 mph.

2.1.9. All the actions by Instructor Pilot to recover the aircraft engine performance / operation were unsuccessful.

2.1.10. Instructor Pilot analyzed the abnormal situation and decided to force land the aircraft in Malir Cantt area as he observed the aircraft losing altitude and speed he would not be able to reach the JIAP runway 25R in glide.

2.1.11. He started to turn the aircraft towards left for the selection of suitable force landing field / area as he saw the high tension wires between his aircraft and JIAP runway 25R.

2.1.12. After turning left through 90^0 Instructor Pilot picked up the unprepared track and started to make approach for force landing and used shallow angle of bank for aligning his aircraft with the unprepared track. During this time the speed of aircraft continued to drop and stall warning was heard just before touchdown.

2.1.13. Instructor Pilot continued the approach with shallow angle of bank till almost round out height.

2.1.14. The aircraft while still flying in air, when the nose wheel impacted with the side surface of a concrete wall in shallow angle of bank at around 10 to 12 ft AGL.

2.1.15. As a result of this impact, the nose wheel got dislodged and flew away from aircraft structure.

2.1.16. By this time, the right horizontal stabilizer came in contact with the top flat surface of the same concrete wall and got completely smashed / destroyed.

2.1.17. After this impact, the aircraft flew at around 7 to 8 ft AGL in almost wings level state before its right wing impacted with another concrete wall which resulted in severe damage to the right wing.

2.1.18. As a result of this impact, the right wing fuel tank got ruptured and fuel started to leak from the fuel tank.

2.1.19. After the impact of right wing with the concrete wall, the aircraft came to very low speeds and it just sat on the ground. The observed aircraft dragging marks were not more than 3 to 4 ft on ground.

2.1.20. The aircraft after force landing was immediately cordoned off.

2.1.21. The fire crash tender reached the occurrence site in a very short time and as the fuel was seen leaking of the right wing tank, therefore the fire crash tender was used as a precautionary measure to avert any post occurrence ground fire.

2.1.22. The aircraft was observed resting on its nose bottom area (due to flown off nose landing gear) and main wheels.

2.1.23. During the entire abnormal situation handling, Captain remained cool and calm while taking all desired / recommended actions and decisions in an extremely professional manner to ensure a safe and successful forced landing on unprepared track / ground surface.

2.1.24. Captain carried out all the recommended actions for making the cockpit safe before carrying out emergency evacuation and guided student pilot to evacuate the aircraft.

2.2. Technical

2.2.1. The aircraft was serviceable and it had flown three flights without encountering any problem in the aircraft and engine performance on the day of accident before the mishap training flight.

2.2.2. During the training area operation, no abnormality in the aircraft or engine performance was observed by the cockpit crew.

2.2.3. The flight remained uneventful with aircraft all systems / sub-systems performance perfectly fine until short finals. About 3 nm short of runway, when the Captain (pilot flying) reduced power from 2300 to 2000 rpm, the rpm started to unwind and reduced to 1000 rpm along with reduction in speed.

2.2.4. After failing to get the desired power from the engine, the Captain decided to make a forced landing.

2.2.5. The aircraft was properly serviced and had no outstanding snag before the flight.

2.2.6. The fuel and oil were fit for use on aircraft.

2.2.7. There was no fuel or oil starvation during the flight.

2.2.8. There was no discontinuity in the electrical supply system.

2.2.9. The internal parts of the engine were in good condition and did not show any pre-occurrence failure signs.

2.2.10. Carburettor got disengaged from the engine by frictional force after it came in contact with ground due to breakage of nose landing gear.

2.2.11. Throttle Control Cable was broken due to ductile overload when the carburettor rubbed against ground.

2.2.12. The Mixture Control Cable slid out of the bolt-hole of its connecting bolt on the carburettor in air during routine service.

2.2.13. Dislodgment of the Mixture Control Cable from the bolt-hole of its connecting bolt on the carburettor resulted in lean air-fuel mixture followed by engine power loss.

2.2.14. Mixture Control Cable was not secured properly at the time of installation.

2.2.15. As per Cessna Model100 series Service Manual (1963 through 1968), after installation of the cable in the bolt-hole and tightening the nut, the extreme end of the cable should be bent 90° to avert dislodgment of the cable during routine service; however, it was not followed.

2.2.16. Life expired engine controls (mixture and throttle controls along with their attachment bolt and nut assemblies) were used during re-installation of engine after overhaul.

2.2.17. The improved bolt and nut for connecting the mixture control with carburettor recommended by the OEM to enhance security of mixture control cable against dislodgment was not used.

2.2.18. Maintenance on the aircraft (Cessna, Reg # AP-BHT) had been done since its induction without a Maintenance Manual approved by DG CAA Pakistan.

2.2.19. Airworthiness Directorate, CAA Pakistan did not ensure availability of a Maintenance Manual approved by DG CAA Pakistan before issuing maintenance organization approval and "C of A" to Schon Air.

2.2.20. No action was being taken by Schon Air and Airworthiness Directorate, CAA Pakistan to ensure implementation of the OEM recommendations received through applicable Service Information Letters.

3. Conclusions

3.1. The dislodgment of Mixture Control Cable from the bolt-hole of its connecting bolt on the carburettor, due to re-use of life expired engine controls (Throttle and Mixture along with their hardware) and incorrect installation and security of mixture control cable contrary to the OEM recommended standard procedure by the maintenance organization (Schon Air) at engine TBO during re-installation of engine after overhaul, resulted in the lean air-fuel mixture and caused sudden loss of engine power on short finals. Also, the improved bolt and nut recommended by OEM to enhance security against dislodgment of mixture control cable were not used.

3.2. CAA Pakistan could not check re-use of life expired engine controls (Throttle and Mixture along with their hardware) contrary to the OEM recommended procedure in

the service manual at the time of inspection for "C of A" renewal due to non-availability of CAA approved maintenance program.

3.3. Additionally, the implementation of OEM recommendations regarding the use of improved bolt and nut to enhance security against dislodgment of mixture control cable was not ensured by CAA Pakistan.

4. Finalization

4.1. The non-conformance of OEM recommended procedures regarding replacement of lifed engine controls and non compliance of OEM instructions regarding use of improved bolt and nut at operator level along with inability of CAA Pakistan to ensure implementation of OEM recommended procedures and instructions which resulted in dislodgment of Mixture Control Cable from the bolt-hole of its connecting bolt on the carburettor and caused the accident.

5. Safety recommendations

5.1. CAA Pakistan is to ensure strict compliance of her directives by general aviation operators regarding student pilot flying prior to issuance of Student Pilot Licence.

5.2. CAA Pakistan is to ensure that no maintenance organization undertakes maintenance of an aircraft on the registry of Pakistan unless it possesses a Maintenance Manual approved by DG CAA Pakistan for that aircraft.

5.3. CAA Pakistan is to ensure that Air Operator's Certificate (AOC) is not issued to an organization unless it possesses and provides for guidance of maintenance personnel performing maintenance on its aircraft a Maintenance Manual approved by DG CAA Pakistan for that aircraft as required under CAR's Rule 30.

5.4. CAA Pakistan is to ensure that "C of A" is not issued in respect of any aircraft unless the organization proves that maintenance on that aircraft has been carried out in accordance with a Maintenance Manual approved by DG CAA Pakistan for that aircraft.

5.5. CAA Pakistan before approval of Maintenance Manual for an aircraft is to ensure that the requirements listed in Duplicate Inspection Checklist / Task Card prepared by the operator / maintenance organization is verified so that it covers elaborately all the vital steps as per the OEM recommended procedures in the applicable service manuals / publications .

5.6. CAA Pakistan is to study and devise a mechanism for strict implementation of Duplicate Inspection System of all vital points and control systems by all operators, maintenance organizations and airworthiness inspectors.

5.7. CAA Pakistan is to study and review the scheduled inspection frequency of those critical mechanical linkages of aircraft on the registry of Pakistan which may jeopardize the safety of aircraft flying operations.

5.8. CAA Pakistan is to ensure that no aircraft registered in Pakistan is permitted to fly unless it is being maintained, serviced and periodically inspected in accordance with

the Aircraft Maintenance Program / Schedule / Manual approved by Director General CAA as required under CAR's 1994, Rule 27.

5.9. CAA Pakistan is to ensure that applicable checklist and forms are used for carrying out inspections of organizations and aircraft whenever required.

5.10. CAA Pakistan is to ensure that only the authorized officials sign the important documents / certificates.

5.11. CAA Pakistan is to review its procedures in order to ensure that a logical and proper channel of command is followed for issuance of approvals / authorizations.

5.12. CAA Pakistan is to ensure that the observations listed at **Appendix "U"** are cleared by Schon Air.

5.13. All operators and maintenance organizations are to carry out one time inspection on all aircraft held on their inventory to ensure that such critical mechanical linkages on the aircraft and engine controls are properly installed and secured as per the OEM recommended procedures in the relevant service manuals / publications.

5.14. All operators and maintenance organizations are to ensure that life expired items are not re-used on any of the aircraft and engine systems / sub-systems.

5.15. All operators and maintenance organizations are to ensure that vital points and control systems are clearly identified from the applicable service manuals / publications and listed in the maintenance program / schedule / manual approved by DG CAA Pakistan.

5.16. All operators and maintenance organizations are to ensure that their respective Quality Control & Quality Assurance Departments perform over the shoulder inspection and independent duplicate check of all vital points and control systems as required by ANO 001-AWRG-5.0, Para D11.4.

5.17. All operators and maintenance organizations are to ensure that the requirements listed in Duplicate Inspection Checklist / Task Card cover elaborately all the vital steps as per the OEM recommended procedures in the applicable service manuals / publications.