

***SAFETY & INVESTIGATION BOARD
PAKISTAN CIVIL AVIATION AUTHORITY***

AIRCRAFT ACCIDENT INVESTIGATION REPORT

AP-BDX CESSNA-172 XP

PAKISTAN AVIATORS AND AVIATION (PVT) LTD



**FORCED LANDING NEAR MULTAN
DUE TO FUEL STARVATION**

AIRCRAFT ACCIDENT INVESTIGATION REPORT
FORCED LANDING NEAR MULTAN ON 31 JULY, 2004
AP-BDX CESSNA-172 PAKISTAN AVIATORS & AVIATION

SUMMARY

1. A Cessna-172 with four persons on board, including an instructor pilot and student pilot, was on a training flight from Karachi to Lahore. The aircraft called Multan ATC at 1611 hours and then reported Molta at 1625 hours, joining point for Lahore 62 nm East of Multan. The aircraft was maintaining FL 075 and gave his intention of proceeding to Lahore. At 1643 hours and 35 nm out, aircraft again called Multan and gave estimated time of landing at Multan on the hour i.e. 1700 hours. The reason for landing at Multan was announced to be "refuelling". At 1655 hours when 25 nm short of Multan, clearance to descend to FL 025 was taken. At 1705 the aircraft announced partial loss of power and gave intentions of forced landing. The aircraft forced landed in a cotton field 13 nm East of Multan after few minutes. The aircraft sustained minor airframe damage and there were no injuries to the persons on board.





Aircraft History

2. The aircraft was manufactured in 1979 and registered with PCAA on 13 January, 1990 by Pakistan Aviators and Aviation (Pvt.) Ltd. The aircraft documents show no accident history. The details are as follows:-

Registration # :	AP-BDX
Certificate of Air Worthiness :	25 June, 2004
	Validity 24 June, 2005
Airframe Hours :	2836 hrs Approximately
Engine Hours :	996:45 hrs Approximately
Propeller Hours :	McCanley VP 400 hours
Dry Empty Weight :	1682 lbs
Engine Type	Continental 10-360 KB2

3. **GENERAL DESCRIPTION CESSNA R-172.** Cessna Model R-172 Series aircraft is high-wing monoplane of all metal, semi-monocoque construction. The aircraft is equipped with a fixed tricycle landing gear with tubular spring-steel main gears struts. The nose gear steer is equipped with an air-hydraulic fluid shock strut. Standard seating accommodations consists of individual, reclining back, pilot and co-pilot seats and dual reclining back, bench-type centre seats. A fold-up auxiliary rear seat may be installed as optional equipment. A baggage area is provided aft of the centre seats when the auxiliary seat is folded up. This aircraft is powered by a Continental IO-360 six-cylinder, horizontally opposed, air-cooled, fuel injection engine, driving an all metal, constant-speed propeller. The aircraft feature rear side windows, a "wrap-around" rear window and a swept back fin and rudder.

Gross weight:	2550 lb
Fuel capacity:	Total 68 gal Usable 66 gal
Engine model	continental io-360
Propeller	McCauley
Wing flap travel	0-40 degrees
Parallel to water line	16 -10 Degrees
Perpendicular to high line	17- 44 degrees
Elevator Travel	Up 28 degree Down 23 degree

4. **Principal Dimensions**

Wing Span (with Strobe Lights)	35' 9"
Track Width (Tubular Spring)	8'1.6"
Tail Span	12'3.14"
Length	27'3.14"
Main Wheel Tyre	6.00 x 6, 6- Ply rating 38 PSI
Nose Wheel Tyre	5.00 x 5, 6- Ply rating 45 PSI

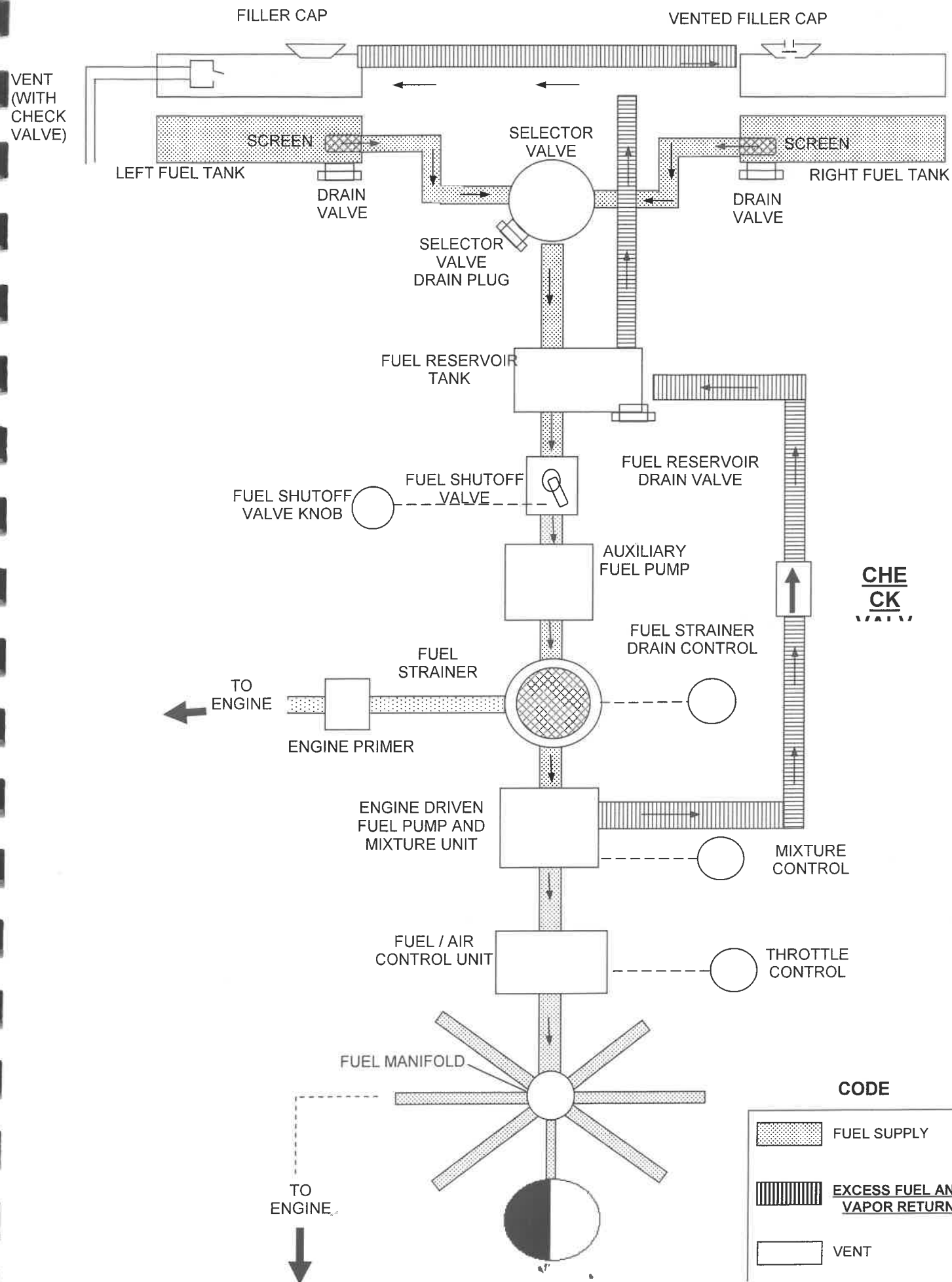
5. **General Description Of Engine Cont.10-360.** An air-cooled, wet-sump, six-cylinder, horizontally- opposed, Continental IO-360-K engine, equipped with fuel injection, is used to power the aircraft. The engine features include valves, with individual rocker box covers for each valve. The intake ports are located on the opposite side of the cylinders from the exhaust ports. An oil cooler is located at the rear (accessory case) end of the engine on the 2-4-6 side.

Model	Continental io-360-kb2
BHP at RPM	195 at 2600 rpm
Number of cylinders	6-horizontally opposed
Displacement	360 Cubic Inches
Bore	4, 438 Inches
Stroke	3, 875 Inches
Compression Ratio	8.5:1
Magnetos	Bendix – Scintilla S6LN- 25
Firing Order	1-6-3-2-5-4
Spark Plugs	18mm
Torque Value	330 # 30lb-in
Fuel Metering System	Continental Fuel Injection
Un-metered Fuel Pressure	6 to 8 PSI at 600 RPM 23 to 26 PSI at 2600 RPM
Nozzle Pressure	2:5 to 4.0 PSI at 600 RPM 14.0 to 16.0 PSI at 2600 RPM
Oil Sump Capacity	8 U.S. Quarts
With Filter Change	9 U.S. Quarts
Tachometer	mechanical
Oil pressure	Minimum Idling 10 PSI Normal 30 to 60 PSI Maximum 100 PSI
Oil Temperature	
Normal Operation	Green 100-240 degree F

Maximum Permissible	Red above 240 degree F
Cylinder Head Temperature	Maximum 460 degree F
Dry Weight with Accessories	325 lb
Propeller Direction of Rotation	Counter clockwise.

6. **Maintenance Schedule.** Revised maintenance schedule of Cessna 172 series aircraft of Pakistan Aviators and Aviation (Pvt.) Ltd was approved by Director Airworthiness on 03.11.2003 vide reference No. HQCAA/2210/74/AW dated 03.11.2003. Last weighing of the aircraft was carried out on 19.11.2003, which is valid till 18.11.2007. Empty weight of the aircraft including un-usable fuel was 1682 Lbs. The MEL on the said aircraft is not approved. However, operator has submitted the MEL to CAA for its approval. Record does not indicate any defect reporting or rectification neither in Lahore nor in Karachi.

6. **FUEL SYSTEM.** This aircraft is equipped with an optional long range fuel system. The standard and long range systems are essentially the same, differing mainly in fuel tank capacity. The extended range system consists of an integral fuel bay in the inboard end of each wing. Fuel flows by gravity from an integral fuel bay area in each wing through a three-position fuel selector valve, fuel reservoir tank, fuel shutoff valve, auxiliary fuel pump, fuel strainer, engine-driven fuel pump and mixture unit, to a fuel/air control unit, which directs the flow to the engine fuel manifold and fuel flow indicator. Depending upon selector valve handle position, fuel is directed from bays to the engine through other components of the system. Positive ventilation for the systems is provided by a vent line and check valve assembly located in the left wing bay, a cross over vent line connecting the two bays. The vent line from the check valve assembly extends overboard through the lower wing skin adjacent to the left wing strut. The reservoir tank has a vapour return line from the engine and a vent line connected to the tank crossover line.



7. **DAMAGE REPORT.** On 31.07.2004 Cessna-172 aircraft AP-BDX force landed in Cotton field near Multan at 1606 hrs. On 01.08.2004 the site was visited and found right hand landing gear of aircraft turned by 60 degree up and right hand horizontal stabilizer resting on ground. During inspection following were observed

Wings

Right hand wing: A deep dent on the leading edge of the wing.
Upper and lower skin of the wing was wrinkled.
Tip fairing broken.

Left hand wing

Two dents on leading edge
Several rivets on leading edge sheared
Stall warning pick up broken.
Wing Tip fairing and Nav.light broken.

Flaps: Flaps were at zero position and selection of flaps in the cockpit was also at 0 degree.

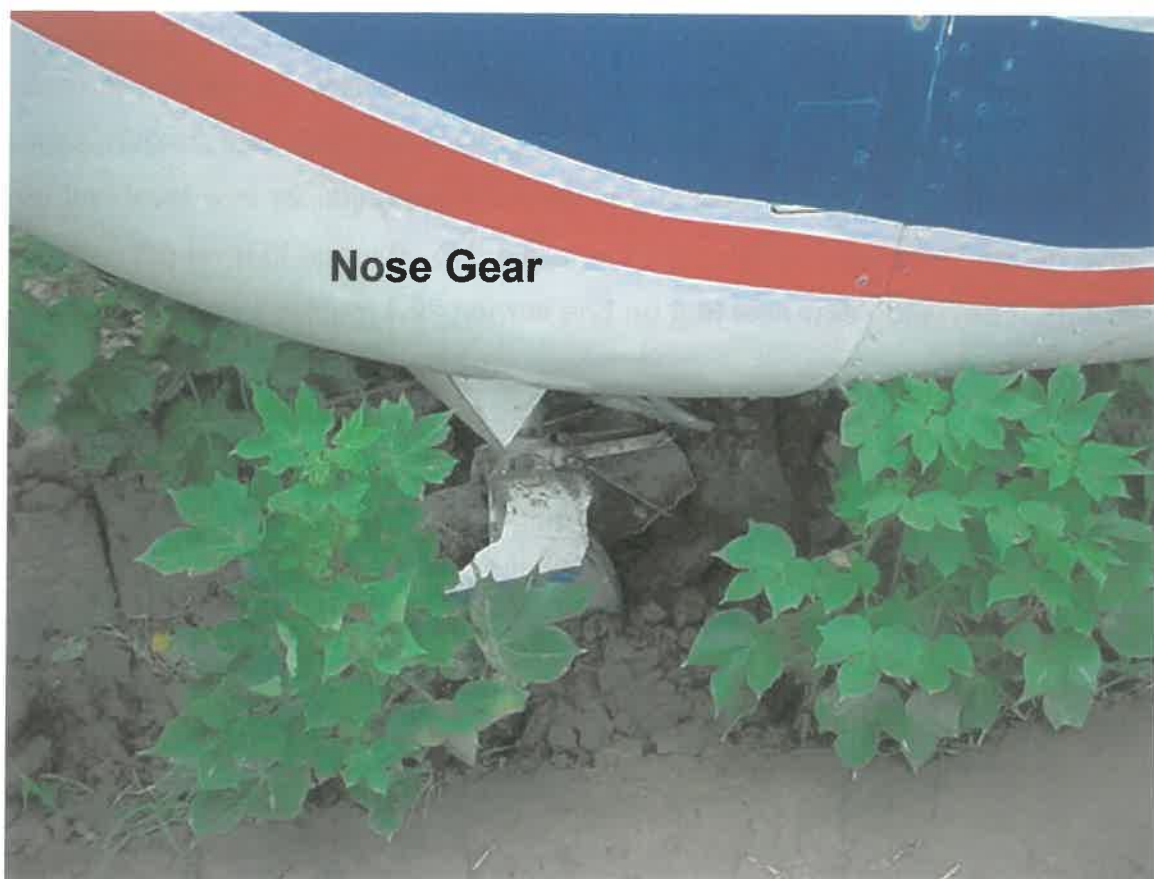
Fuel System: Left and Right both fuel tanks were empty, No fuel leakage was observed. Vent system was OK. Fuel lines were intact.

Engine. There were no sign of damage on engine. Oil level was satisfactory and no oil leak was observed. Propeller rotation was normal without any noise. No damage was observed on the propeller.

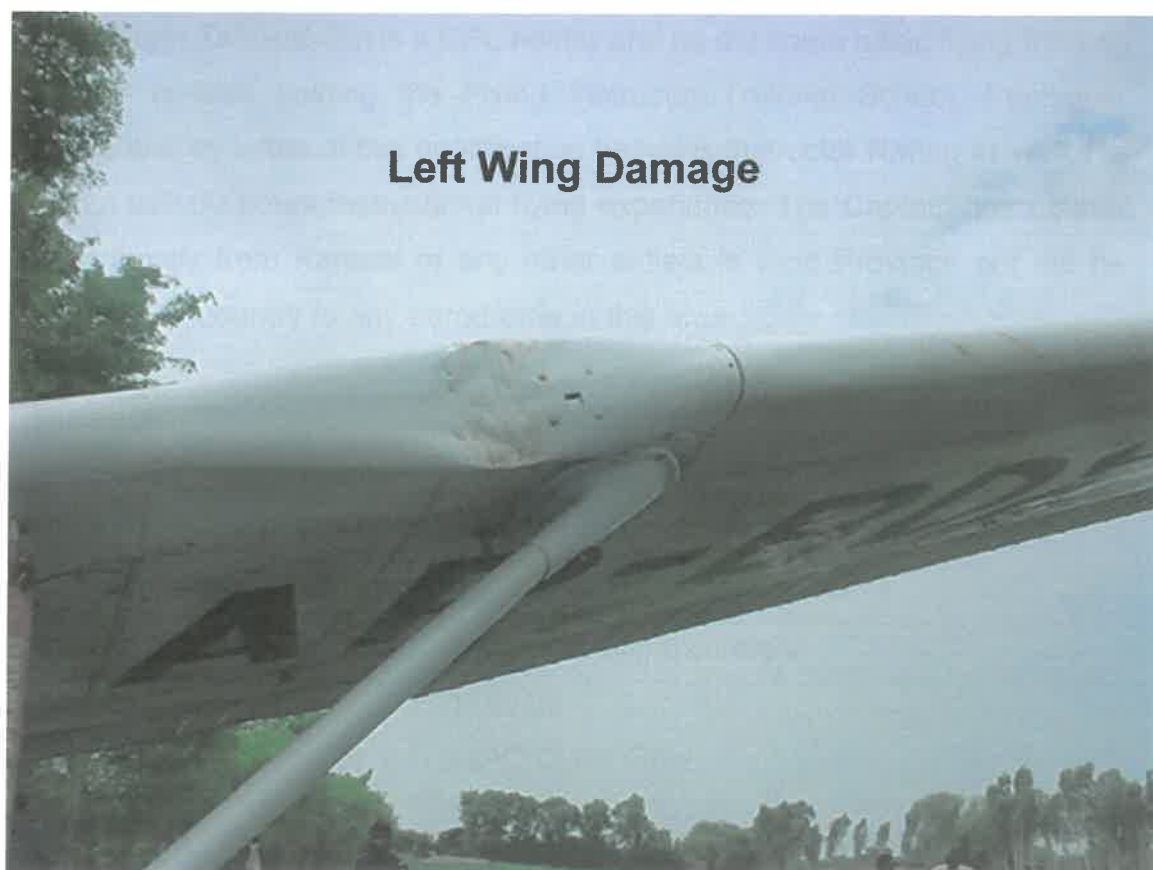
LANDING GEARS. Right hand landing gear fairing was broken. In board forging cross bolt was sheared and gear turned about 60 degree up. Fairings of all three landing gears were broken.

Horizontal Stabilizer. Right hand stabilizer front and rear spars were fractured and skin was ruptured. Leading edge upper skin of elevator was cracked. Static wick from left hand elevator was missing.





Nose Gear



Left Wing Damage

8. **Fuel System Test Report.** After retrieval of aircraft on 11.08.2004, Fuel system of the aircraft was checked at Pakistan Aviators and Aviation (Pvt.) Ltd hangar. Aircraft fuel tanks were filled with fuel with five litres increment. At 100 litres fuel level was touching the lower lip of fuel filter. At 130 litres the fuel tank was full in the level of upper tip of the filler and fuel started over flow through over flow pipe. Fuel vent system was normal and no fuel leak was observed from fuel tank or fuel supply lines.

9. **Engine Ground Run Up.** In order to observe the engine condition and its operation at different RPM, engine ground run up was carried out on 11.08.2004. Engine started in first attempt. At idle RPM engine behaviour was smooth and engine oil pressure and oil temperature were in normal range. The engine performance was checked up to 2550 RPM. All parameters were found in normal limits and engine operation was fine. Duration of engine ground run was about 7 minutes. Engine run up was normal and satisfactory.

Aircrew History

10. **Captain Zaki-ud-Din** is a CPL holder and he did some basic flying training in UK. He is also holding the Flying Instructor Training School, Peshawar Certificate and by virtue of this qualification he holds Instructor Rating as well. He has about 950:00 hours instructional flying experience. The Captain has neither operated locally from Karachi or any other airfield in Sind Province nor did he ever fly a cross-country to any aerodrome in this area.

CPL #:	2327A
Ratings:	IR, C-152, C-172
Instructor Rating:	Yes (FITS)
Experience on Type:	400 hours approximately
Instructional Experience:	950 hours approximately
Total Experience:	1198:55
Medical :	ICAO Class One

Student Pilot Kashif Salman

SPL #: 2534
Experience on Type: 20 hours
Total Experience: 70 hours

Flight Planning

11. **Flight Plan (App 'A')** The flight plan was filed as training for Student Pilot Kashif. Although with same set of crew and two passengers the flight plan was filed as private operations on Lahore-Karachi flight on 29 July, 2004. The flight plan is VMC and time of flight five hours at Cruise speed of 90 kts. The Captain obtained the Met briefing before departure. The designated en-route alternate was Multan.

12. **Navigation Planning** The route was standard ATS designated routes. The TAS calculated was 90 kts and calculated ground speed for winds 230⁰/15 kts was 120 kts. The Met forecast for the day gave WSW/10 kts winds. With these parameters estimated time to Lahore was five hours and time to Multan about four hours. These timing cater of initial climb and change of designated altitudes by Radar. The flight was under positive Radar Coverage.

13. **Fuel Planning.** The aircraft has a fuel capacity of 34 Gallons in each wing tank. The total fuel, therefore, is 68 Gallons and two gallons is un-useable. The fuel quantity is indicated in the Cockpit on two independent fuel gauges, which show fuel quantity remaining in respective left or right wing tanks. In addition, fuel flow per hours to the engine is indicated on a separate gauge. In addition, Fuel quantity can be checked physically in pre-flight by opening the filler caps. A dip stick gives approximate fuel in each tank and error is subject to the aircraft levelling. The maximum fuel consumption with maximum power at sea level is 16 gallons/hour and at 6000' AMSL & 8000' AMSL it reduces to 13 gallons/hour and 12 gallons/hour respectively. At 2300 RPM and planned 95

KTAS the fuel flow at 6000' AMSL and 8000 AMSL are 8.4 gallon/hour and 8.2 gallons/hour respectively.

14. **Weight and Balance**. The aircraft's basic Dry Weight is 1592 lbs and maximum take off weight is 2550 lbs. Because of add-ons and repairs over 25 years since manufacture, the basic dry weight has increased to 1682 lbs as on C of A on 25 June, 2004. The usable 66 gallons fuel weighs 396 lbs. In addition to capacity of four seating including pilots, there are two baggage compartments with a combined maximum allowable weight limit of 200 lbs. With four occupants' and no baggage the aircraft can lift a maximum 50 gallons fuel. However, with increase in weight of AP-BDX by 90 lbs over its service life, the aircraft could carry a maximum 35 gallons fuel with four occupants (standard average weight 75 kg per person).

Flight Details

15. **Pre-Flight**. On 29 July, 2004 the aircraft flew Lahore-Multan-Karachi with same 4 persons and baggage, and 26 gallons fuel was taken from Multan. The journey from Lahore was started with full fuel. On arrival at Karachi the aircraft fuel was topped-up from drums, therefore, fuel serviced quantity cannot be ascertained accurately. The post flight and pre-flight inspections were carried out by the Captain, who is authorized to do so. As per Pilot's statement he was carrying a total of 60 gallon fuel from Karachi, which he checked by opening the filler caps and found fuel level at Filler-Cap collar level. Before the flight two ground engine run-ups of 3-5 minutes each were carried out on 30 and 31 July, 2004 by the Captain without refuelling.

16. **Flight Profile** The aircraft started up at 1030 hours LT and took off at 1052 hours LT. The aircraft climbed to FL 055 and maintained till Nawabshah. From Nawabshah to Rahim Yar Khan FL 085 was maintained and then FL 075 up to Molta. The Karachi-Nawabshah- Rahim Yar Khan- Molta track is 040 ± 02^0

and winds en-route were also the same. After level off, the aircraft maintained 110-115 kts. AP-BDX reported Murli at 1450 hours and gave estimates for Molta to be 1511 hours. At 1511 hours the aircraft called Multan for a radio check only. Later at 1525 hours Multan was called again on position Molta and change-over to Lahore was announced. However, the aircraft called Multan again at 1543 hours LT, announced intentions of landing at Multan at 1600 hours and reported 35 nm out. When 25 nm short of Multan, AP-BDX took clearance to descend to FL 025. At this time the aircraft announced landing at Multan for refuelling. At 1605 partial loss of power was announced by AP-BDX and intention of forced-landing. The aircraft landed in a cotton field on a heading of 030 and came to stop after 180-200 feet of ground role.

Witness Evidence

17. **Captain** Captain states that on each refuelling on coming from Lahore and while proceeding back from Karachi he had about 60 gallons fuel. Each time he visually checked the fuel level after opening filler cap and it was up to the Filler Cap neck level. Therefore, fuel carried from Karachi was 60 gallons. He also states that fuel quantity gauges are not reliable; however, both gauges were serviceable before departure. He also states that he filed wrong flight plan by mistake and stating that to be training sortie, in fact, that was a private operation as on Lahore-Multan-Karachi flight. At Karachi neither any maintenance work was undertaken on the aircraft, nor was aircraft scheduled for any other flight except mishap flight. Captain also states that engine ground run was given on 30 and 31 July, 2004. He maintained a 9 Gallon / hour fuel flow all along his navigation and sites bad weather after Rahim Yar Khan. To avoid bad weather he had to make several dog-legs till he reached Molta. In his assessment he got a speed of 80-85 kts IAS. When he decided to land at Multan due to weather his fuel was about quarter (8 gallons in each tank) on the gauges and when he experienced engine rough running it was about the same. The engine, rough running was experienced at 4000' AMSL and in one / two minutes

they forced landed. He states that engine was running with 1200 RPM but fuel flow had dropped. No attempt to relight the engine was made due to low altitude.

18. **Chief Flying Instructor** Following are the salient aspects of the statement:-

- a. CFI agreed on the need of a route check, however, he was satisfied with the experience and skill level of Captain Zaki to take a flight to Karachi.
- b. CFI was aware that left fuel gauge was unserviceable and it had been blanked.
- c. The fuel quantity can be checked visual by checking fuel level up to filler Cap-Collar; it would be 30 gallons in that tank.
- d. Minimum planed fuel on landing should be 30 minutes i.e. about 10 gallons.
- e. He knew about the number of persons on board, basic dry weight of the aircraft and total fuel on the aircraft before departure.

19. **Chief Engineer.** Salient points of Chief Engineer's interview are as follows:-

- a. Right fuel gauge was on MEL since 2-3 days before the 29 July, 2004 flight, as the gauge was unserviceable.
- b. The case of approval of MEL on the basis of MMEL has already been taken up with PCAA.

20. **Post Accident Inspection** The aircraft was inspected for causes of engine flameout/engine failure. The aspect considered are as follows:-

- a. Mechanical failure
- b. Interruption in fuel supply
- c. Fuel Starvation

21. **Mechanical Failure.** An inspection of engine revealed no fuel/oil leaks or any broken/cracked component. The propeller was rotating freely and there were no damage to propeller. The spark plugs were in good condition.

22. **Fuel Supply.** The aircraft fuel system was checked for broken/interrupted fuel lines and fuel leak. No fuel leak was observed and both the tanks were found empty. On recovery to the flight lines later, the fuel tanks were tested for leak and no leak was observed from the tanks and fuel lines. The complete aircraft fuel system and engine fuel system were in continuity. The left fuel gauge was found serviceable.

23. **Fuel Starvation.** On battery power left tank fuel gauge read below zero. In view of the empty tanks, presence of fuel in the lines and fuel filter was checked. The closing of fuel cock in the cockpit traps the remaining fuel in the line to fuel filter sump. Some contaminated residual fuel was found below the level of engine fuel system inlet, indicating interrupted fuel supply due to starvation. The opening of fuel cock in the cockpit also did not release any fuel in the fuel filter, confirming fuel starvation to engine fuel system.



ANALYSIS

24. The evidence suggests that aircraft engine flamed, out due to fuel starvation. The engine flame out due to starvation may be caused for the following reasons:

- a. Fuel Leakage
- b. Low Fuel Quantity vis-à-vis the profile flight

Fuel Leakage

25. On post accident inspection no signs of fuel leak were observed from the fuel tanks, fuel lines and engine fuel system. On switching the aircraft battery on power supply to left fuel gauge was available and it read empty. The right fuel gauge was unserviceable and thus it had been blanked. The reliability of fuel gauge quantity indication is fairly good, however, it does not give quantity precisely, yet, a good assessment of "less than" and "more than" of quarterly graduations on the gauge can be made. Each quarter represents 8.5 gallons fuel in respective tank and that is sufficient for one hour endurance at 5000' AMSL. The undertaking of planned cross country flight-with right fuel gauge unserviceability is in contravention of PCAA rules / regulations as no MEL (Minimum Equipment List) on the basis of MMEL (Master Minimum Equipment List), as provided by the manufacturer, is approved on Cessna-172. However, operator asserts that case for approval of MEL on one unserviceable fuel gauge has been taken up with PCAA. Therefore, any leakage in right fuel tank or in associated independent supply lines to the engine could not be seen by the pilot; however, there is no possibility of such leakage affecting the quantity and supply of left tank. The fuel quantity in left tank would have alarmed the pilots well in time, if right tank quantity depleted due to leakage. The aircraft fuel system maintenance inspection in the hanger after the mishap, however, did not reveal fuel leakage.

Fuel Quantity Vs Flight Profile

25. The aircraft has a total capacity of 68 gallons fuel and two gallons are unusable. For the flight profile, as given in the flight plan by the Captain, Cessna-172 should fly for at least seven hours before its fuel tanks go dry. In view of this fact following aspects need to be analysed:

- a. Change in Flight Profile.
- b. Fuel Adequacy for the Flight

26. **Change In Flight Profile** The change in flight profile due to weather or rerouting can adversely affect the fuel planning and if fuel is not monitored carefully then it may reach critical level when still far away from an aerodrome. In mishap flight the pilot or ATC did not deviate from the planned route. The Pilot asserts that he had to make several dog-legs to avoid weather enroute while staying within the ATS route, however, the weather forecast of the day did not show any clouds / thunder on that route and radar picture also shows a steady track of mishap aircraft all the way to Molta. Furthermore, the flight was undertaken at an altitude higher than the planned altitude, therefore, possibility of high fuel consumption due to lower altitude is also ruled out. In addition, pilot stated that he selected 09 gallons / hour fuel flow throughout his cruise. The radar picture shows 110 kts aircraft ground speed after level off, which is about 10 kts less than the performance charts owing to 12% more than maximum take off gross weight.

27. The distance between level off point and Murli is 335 nm and at an average of 110 kts GS the flight time is three hours. The aircraft levelled off Badal at 1109 hours LT and reported Murli at 1450 hours LT. In between aircraft was asked to change altitude to FL 085 and then FL 075 which were achieved with fixed power as maximum boost (manifold pressure) is reached at about 6000' AMSL. At FL 085 and FL 075, though the TAS increases for same IAS, but less power results in no appreciable change in GS. However, Climb speeds

reduce and thus the GS and acceleration to cruise speed is extremely slow after level off. The 12% increase in MTGW also adversely affects the attainment of schedule climb and cruise. These factors combined together and evidence of radar picture shows that aircraft took almost 40 minutes more to reach Murli, because the cruise speed had been average 100 kts. Furthermore time to Molta was 4:05 hours since aircraft reached desired altitude and started cruising for a distance of 410 nm, showing an average GS 100 kts. It also shows that Murli call was late.

28. From Molta aircraft changed over to Lahore and came back to Multan frequency at 1543 hours LT for landing, reporting 35 nm out. The distance between Molta and Multan is 62 nm; and flamed out landing 14 nm short of Multan after 40 minutes also suggest that aircraft proceeded to Lahore for some time and then turned back for Multan. The total time of flight till flameout is five hours and ten minutes approximately as against over seven hours endurance with full fuel. Moreover, time of flight in the flight plan is also five hours. These factors suggests that the aircraft was cruising at low speeds and almost 20 gallons fuel was not available. The leakage of 20 gallons fuel cannot go unnoticed on fuel gauges if it was gradual over five hours flight; and sudden leakage would be clearly visible to the rear seat passengers as entire fuel system is located ahead of them. In view of this discussion it can be said with certainty that there was no fuel leakage in the aircraft and all available fuel was consumed by the engine.

Adequacy of fuel

29. **Fuel Requirement** The fuel quantity required for a flight is to be calculated according to Appendix 'B' para 2 to ANO 91,0010. As filed flight plan gave an alternate, therefore, para 2.3 (b) applies. Therefore, for Karachi-Lahore VFR flight Cessna-172 should have seven hours fuel for the flight of five hours. In this case weather at Lahore was unpredictable over five hour's flight due to monsoon period. If there was a reasonable certainty of weather being favourable

for VFR flight and visual landing then 6:30 hour's fuel would have been adequate. In view of the planed flight profile and fuel capacity available, the aircraft required full fuel for direct flight to Lahore. However, with maximum fuel only three passengers with a combined weight of 520 lbs could board the plane due to MTGW. The Cessna-172 XP Flying Order#6 issued by Pakistan Aviators and Aviation Ltd. also requires pilots to carry maximum fuel.

30. **Fuel Carried** There was no document prepared at Karachi, which indicated the fuel quantity serviced on the day of arrival. The Captain, who carried out the post flight states that fuel servicing was supervised by him and he got tanks filled to the level of filler cap collar, which is 30 gallons in each tank. On Lahore-Multan-Karachi flight Captain states that he carried total 60 gallons from Lahore and again filled up to 60 gallons at Multan. However, the refuelling documents show 68 gallons fuel serviced at Lahore and 100 Litre serviced at Multan (App 'C'). At Multan Captain visually checked the fuel and found that to be at the neck of the filler cap collar. The Captain, the Student Pilot and the Chief Flying Instructor Pakistan Aviator and Aviation (Pvt.) Ltd. state that when fuel level is up to the neck of filler cap collar the fuel quantity in each tank is 30 gallons i.e. total sixty gallons, however, Pilot's Operating Hand Book clearly gives this quality to be 100 Litres or 26 gallons approximately in each tank. The aircraft parking level, oleo condition of main gears, nose gear oleo and weight distribution of the load in the Cabins certainly changes the visual fuel level assessment. The Post accident tests also confirmed these assumptions. The 100 litres fuel lift off from Multan could also not be explained by the Captain even if he took off with 60 gallons from Lahore. The Lahore - Multan leg was 1:50 hours and a maximum 18 gallons would have been consumed. Even if 60 gallons was taken from Lahore then it would have been topped up with 100 litres addition at Multan, though, the documents, Chief Engineer and CFI state that aircraft carried full fuel from Lahore. Unrecorded statements suggest that more than $\frac{3}{4}$ Barrel of 200 Litres was serviced to the aircraft at Karachi, which is about 40 gallons. These figures also conform to the fuel consumed on Multan-Karachi sector as

per performance chart, if aircraft was topped up at Multan. The post accident engine ground-run report indicates normal fuel flow on different engine settings.

31. **Fuel on Take off** Before flight Captain visually checked the fuel quantity in both tanks and states its level was at filler cap collar neck i.e. about 52 gallons in both tanks. The aircraft remained on ground for almost 20 minutes after start until take off. Long ground holding and flaws in accurate visual fuel assessment suggest that aircraft had about 50 gallons or less on take off. Time to Multan also reflects that aircraft was cruising at lower than performance chart speeds, in spite of favourable winds as aircraft was heavier than maximum allowable weight. This would have also resulted in higher engine settings for desired speeds. Moreover, aircraft flamed-out after five hours and ten minutes since take off, which corresponds to the evaluated fuel on take off.

Observations

32. **Type of operation** The Student Pilot flying from Lahore to Karachi has been logged in Journey Log Book as under supervision and flight plan Karachi-Lahore also indicates a training flight. The PCAA Rules prohibit passengers on training flight, yet, two passengers were carried on both the flights and flights were declared as private operations.

33. **Log of Flying Hours** PCAA Rules do not permit log of flying by two Captains in Cessna-172 flight unless it is a training flight for re-currency / check. The Journey Log Book has numerous examples where two pilots have logged P₁ in a sortie and regular training sorties are flown amongst Captains with P₁ P₁ u/s logging. Similarly in mishap flight Student Pilot is under supervision on private operations Appendix 'D'.

34. **Weight and Balance** Pakistan Aviators and Aviation (Pvt.) Ltd. is not maintaining an up to date record of Trim Sheets (Weight & Balance of every flight) and the records presented were grossly inaccurate, including the mishap flight. On take off from Lahore and Multan AP-BDX was overweight by 12%,

however, on mishap flight the aircraft was about 8% more than maximum allowable weight. Actual weight is given on the trim sheet at Appendix 'E'.

35. **Captain's Experience / Training** Although Captain has over 1200 hours flying experience and 900 hours instructional flying, yet, his knowledge on aircraft and navigation planning is far below the required standards. Following examples indicated low standard:-

- a. Identification of Engine flame out with 1200 RPM and zero fuel flow was taken as engine rough running.
- b. Aircraft was descended to lower altitude in spite of being very low on fuel.
- c. Captain could not distinguish the procedure between a wind milling engine re-light after flame out and fan stop re-light.
- d. Navigation planning was not according to performance charts and application of winds for calculation of ground speeds was grossly inaccurate.
- e. Knowledge on preparation of Trim sheet was inadequate.

36. **Organisation** Pakistan Aviators and Aviation (Pvt.) Ltd. was flying the aircraft with right fuel gauge unserviceable on the basis of MMEL from manufacturer, though, PCAA's Policy does not authorize MEL in this category of aircraft. Moreover, there was no record of right fuel gauge un-serviceability in Tech Log Book and its transfer on MMEL. The anomaly came to notice learnt after the accident as the fuel gauge was found blanked. Furthermore, a pilot was scheduled for the longest ferry without any route-check before, although, he had never flown in Sindh Province or operated from any airfield in Karachi. The company is using Service Manual C-172 1991 Edition and was unable to produce any document on the aircraft, which could show any SBs, AD, or SIDs.

Findings

37. The investigation reveals the following:-
- a. Passengers were on board a training cross-country flight contrary to PCAA Rules.
 - b. Captain of the mishap aircraft was not given a route check on Lahore-Karachi flight and he had never flown/operated in Sindh.
 - c. There was no record on unserviceable right fuel gauge, yet, it was claimed to be on MEL and aircraft was scheduled for flying, though PCAA Rules do not allow MEL on this category of aircraft.
 - d. Captain's knowledge on aircraft fuel system, engine flame-out and re-light procedure, and on navigation planning was inadequate.
 - e. On Lahore-Karachi and Karachi-Lahore (mishap flight) aircraft was 12% and 8% more than maximum allowable take off weight. The maintenance and preparation of Trim Sheet (weight & Balance Report) in the Company is inadequate.
 - f. The practice of visual fuel quality checking in the Company is grossly inaccurate and lack of knowledge on fuel/oil/oxygen ANO resulted in its violation in planning by the Captain and management both.
 - g. On take off at Karachi the aircraft was 8 % more than maximum allowable gross weight and it had about only five hours fuel, which was equal to the time of flight to the destination.
 - h. Flight was planned direct to Lahore, however, when 60-80 nm from Lahore Captain decided to divert to Multan for refuelling.

- j. Few minutes before flame out, joining instructions were taken and aircraft was descended to FL 025.
- k. Aircraft engine flamed out after 5:10 hours flight duration due to fuel starvation, no attempt to relight the engine was made and aircraft forced landed 14 nm west of Multan in a cotton field.
- l. There were no injuries to the occupants of the aircraft and no collateral damage; however, aircraft suffered minor damage.
- m. Post accident on site inspection showed completely dry fuel tanks/lines and maintenance inspection showed no fuel leaks/un-serviceability in the aircraft fuel system or engine.

Finalization

38. The engine flame- out and forced landing was due to inadequate refuelling procedures and wrong fuel management by the Pilot in Command.

Recommendations

39. Following is recommended:-

- a. Pakistan Aviators and Aviation (Pvt.) Ltd. to ensure following:-
 - (i) Ensure correct filling of Trim Sheet, maintenance of Trim Sheet Record and aircraft weight and balance within specified limits.
 - (ii) Accurate record of aircraft un-serviceability and transfer of un-serviceability on MEL only after approval from PCAA.
 - (iii) Adherence to ANO-91.00.10 for fuel requirements on cross-country flights.

- (iv) Logging of individual flying hours as per ANO. 90.0004-25 in all log books.
 - (v) To have up to date record of each type of aircraft where All Airworthiness Directives, Safety Bulletins and Special Inspection Documents are available. Moreover, latest issue of Service Manual to be procured.
- b. All General Aviation Pilots must be given a route check prior to independent operations to Karachi.
 - c. Pilot in Command of mishap flight be given refresher training on Cessna-172 and Instructor Rating, which should include five hours flying and passing Instructor Rating Examination in PCAA before undertaking any instructional flying.
 - d. ANO 91.00.10 Appendix 'B' should be part of Approved Operational Manual in General Aviation.