

No.HQCAA/1901/288/SIB



**CIVIL AVIATION AUTHORITY
PAKISTAN**

**FORCED LANDING INCIDENT
M/S LAHORE FLYING CLUB'S
AIRCRAFT REG # AP-BAH
NEAR NANKANA SAHIB**

ON 15TH MARCH 2004

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FINAL REPORT

FORCED LANDING INCIDENT TO M/S LAHORE FLYING CLUB'S AIRCRAFT REG # AP-BAH NEAR NANKANA SAHIB ON 15 MARCH 2004

1. SYNOPSIS

- 1.1 A Cessna-152 of Lahore Flying Club (LFC), Reg # AP-BAH, took off at 0556 UTC for a training cross-country navigation from Walton to Jaranwala, Sheikhpura and back. The aircraft climbed to 6500 feet for its first leg of navigation i.e Walton to Jaranwala. The student was being practiced in flying for endurance during this leg with lean mixture. At Jaranwala the aircraft descended to 5500 feet for its second leg. By then the aircraft had flown for 45 minutes. When the aircraft was at 5500 feet, the PIC noticed a fluctuation in the engine RPM, which deteriorated soon after its first occurrence. The Capt of the aircraft informed Lahore about the problem and decided to return to Walton. He was allowed to descend to 3500 feet by Lahore as the Capt had requested. As the aircraft descended to 3500 feet, the engine RPM reduced further and soon the engine flamed out. The Capt made a successful forced landing about 37 nautical miles on radial 270 of Lahore VOR, close to Nankana Sahib.

Post Accident Actions Airworthiness Surveyor at Lahore was informed, who in turn informed the Acting DAW at Karachi about the incident. Acting DAW, after discussing with P SIB, briefed the Airworthiness Surveyor PSIB had given specific Instructions that engine should not be started till the cause of the engine failure is established through a thorough inspection of the relative systems. On instructions from the Airworthiness Surveyor, however, the engine was given a ground run after taking the fuel and oil samples. The spark plugs, fuel system, the air filter, carburetor heat system etc were not inspected before giving the aircraft a ground run.

An engine that had flamed out in the air and the aircraft had Forced Landed, is not to be started up without establishing the cause as valuable evidence is lost.

1.2 Crew Information:

1.2.1 Pilot-in-Command

- 1.2.1.1 Name: Mohammed Usman Chaudry
- 1.2.1.2 Position in the Cockpit: Right Seat
- 1.2.1.3 Date of Birth: 31 October 1975
- 1.2.1.4 Type of License held and #: CPL 2259
- 1.2.1.5 Validity of License: November 2004
- 1.2.1.6 Medical date with status: 24 Nov 2003 – FIT

1.2.1.7 Rating:

- 1.2.1.7.1 Type(s) held: C-150/152,
C-172, PA-28
- 1.2.1.7.2 Type Current: C-152, PA-28
- 1.2.1.7.3 Assist/Flight Instructor Rating: FI
- 1.2.1.7.4 Check Rating: Nil.

1.2.1.8 Flying Experience:

- 1.2.1.8.1 Grand Total: 418:05 Hrs
- 1.2.1.8.2 Total In Command: 332:00 Hrs
- 1.2.1.8.3 Total In Command on the type
accident/ incident occurred:
140:05 Hrs
- 1.2.1.8.4 Where trained: Lahore Flying
Club / Pakistan Aviators /
Peshawar Flying club.
- 1.2.1.8.5 Date of Joining the
Organization: 20 May 2003.
- 1.2.1.8.6 Duty Time Started at: 0400 UTC
- 1.2.1.8.7 Duty Time Ended at: 0700 UTC
- 1.2.1.8.8 Personal Schedule of Past 72
Hrs: With his family on Friday
went to a Birthday and Wedding.
With his Wife and Son on
Saturday. Stayed with his family
on Saturday and Sunday.

1.2.2 Student Pilot

- 1.2.2.1 Name: Yasir Rizvi
- 1.2.2.2 Position in the Cockpit: Left Seat
- 1.2.2.3 Date of Birth: 01 April 1986
- 1.2.2.4 Type of License held and #: SPL 2560
- 1.2.2.5 Validity of License: 30 May 2004
- 1.2.2.6 Medical date with status: 02 Sept 2003 – FIT

1.2.2.7 Rating:

1.2.2.7.1 Type(s) held: Student Cessna-152

1.2.2.7.2 Type Current: Cessna-152 Student

1.2.2.8 Flying Experience:

1.2.2.8.1 Grand Total: 30 Hrs 06 Min

1.2.2.8.2 Total In Command: 07 Hrs 25 Min

1.2.2.8.3 Total In Command on the type
accident/ incident occurred: 07 Hrs
25 Min

1.2.2.8.4 Where trained: Lahore Flying Club.

1.2.2.8.5 Date of Joining the Organization:
11 Sept 2003

1.2.2.8.6 Duty Time Started at: 0552 UTC

1.2.2.8.7 Duty Time Ended at: 0652 UTC

1.2.2.8.8 Personal Schedule of Past 72 Hrs:
College, Tuition, Chatting with
friends, staying at home and
watching cricket match. Chatting
with friends on the Internet.
Studying for College Exams.
Spending time with the family and
preparing the navigation.

2. Investigation

2.1 Most piston engines flame out due to one or a combination of reasons enumerated below. The cause can usually be isolated if the engine has not been tempered with in any way:

- i. Magnetos grounding.
- ii. Out of fuel / fuel starvation.
- iii. Carburetor jets restricted.
- iv. Air or vapor lock in the fuel line.
- v. Fuel lines partially obstructed.
- vi. Foreign object in induction system.
- vii. Fuel contamination.
- viii. Broken fuel lines.
- ix. Sheared timing gears.
- x. Internal structural failure.
- xi. Propeller contacting solid object(s).
- xii. Air vent or fuel tank obstructed.
- xiii. Spark Plugs.

2.2 Magnetos

After the aircraft was brought back to the LFC hanger from the forced landing area, magnetos were tested by manually rotating the propeller with opened spark plugs connected to the ignition harness. A spark was generated on the spark plugs connected to each magneto. Magnetos not generating a current was, therefore, ruled out. It was, however, not possible to say if the magnetos were not tempered with. Had the engine not been started magnetos could have been dismantled from the engine and checked individually and independently for their affectivity.

2.3 Fuel Starvation

Fuel tanks were physically checked for fuel on the following day of the incident. There was ample fuel in the tanks and fuel starvation was considered a non-factor at this stage. Lack of fuel in the tanks did not seem to be responsible for the engine failure in air.

2.4 Carburetor Jets Restricted

This could not be ascertained because the Chief Engineer maintained that the carburetor could not be opened due to restrictions by the manufacturer on its opening by the operator. A stuck carburetor pin or floats could not be ruled out.

2.5 Vapor Lock in Fuel Line

This possibility was considered but the ambient temperature was not supportive of this phenomenon occurring. Vapor lock would usually occur during operations at high ambient temperatures. The temperature at the time the engine quit was about 21 to 22°C. A back pressure in the lines with one-way valve unserviceable may cause a vapor lock and the engine could fail. Fast throttle movement could also cause a vapor lock. A determination of this fact would require seeing an engine that has not been tempered with, which in this case was not possible as the engine had been started and the vapor lock could not have been established.

2.6 Foreign Object in Induction System

Since the engine was started up after obtaining the fuel/oil samples, without establishing the cause of the Engine Failure, it may be concluded that the induction system did not have a foreign object that could permanently block the induction system. Induction system getting blocked or obstructed temporarily by foreign objects, however, cannot be ruled out. In his statement the pilot has mentioned that the propeller was wind milling (Annex 'E1'). The obstruction could have cleared up during the cranking process, while not getting cleared with a wind milling propeller.

2.7 External / Internal

Fuel lines were inspected on arrival at the scene. There was no visible damage or breakage anywhere in the fuel lines. The aircraft was inspected thoroughly to see if there was any internal structural failure or the timing gear had sheared. No evidence of broken fuel lines, internal structural failure or sheared timing gear was found on the aircraft.

2.9 Propeller Contacting Solid Objects

There was no visible damage on the propeller, which indicated that it had not hit any solid object. Had the propeller hit any solid object there would have been marks indicating such a contact.

2.10 Air vent of Fuel Tank Obstructed

This possibility was looked into but no blockage was found in the air vent or fuel tanks. This possibility cannot be ruled out totally as it requires purging of the air vent system.

Visual inspection was carried out and no blockage was found. Before starting the engine, however, fuel tanks should have been emptied and all vent lines should have been purged to check for air vent blockage, which was not done.

Later, when the system was purged a blockage could not be determined. Evidence of this nature would usually be lost if an engine is started without first investigating the blockage in the lines.

2.11 Spark Plugs

There were two types of spark plugs installed simultaneously on the same engine. Spark plugs installed on the upper side of the cylinders were REM 38E, while those installed on the lower side of the cylinders (bottom plugs) were REM 37 BY. Out of the four similar types of spark plugs used on the upper side of the cylinders, three were of the same size, while one was larger in size. The same was true for the bottom four spark plugs. The manufacturer allows the use of two types of spark plugs namely Champion REM 37 BY and REM 38E on Lycoming Engines 0-235-L2C, the like of which was installed on AP-BAH. The manufacturer, however, does not recommend any mix of the types to be used on the same engine. It recommends the use of quantity 8 spark plugs of any one type to be used on the same engine.

The two types of plugs used in AP-BAH were issued from LFC store against AP-BAH as follows:

- a. Qty eight spark plugs type REM 37 BY issued on 20 June 2003.
- b. Qty four spark plugs type REM 37 BY issued on 10 March 2004.

The incident took place on 15 March 2004. When the plugs were scrutinized none of the plugs showed that they had been used for 5/6 days only. Their internal condition, physical external and internal appearance and the numerous wrench marks visible on them, all belied that any of the plugs was 5/6 days old. It was observed that the plugs issued for AP-BAH from the store were all of type REM 37 BY whereas the plugs recovered from the engine were a mix of REM 37 BY

and REM 38E. There was no record to show as to where and when type REM 38E were brought and installed on AP-BAH.

2.13 Spark Plugs – Test Report

There are eight spark plugs installed on the engine, two on each of the four cylinders. These were tested (Annex 'A'). Out of the eight spark plugs installed on the aircraft engine, seven were weak, intermittent or dead, only one spark plug tested 'good' for spark. The details of their performance are appended below. While a cold engine may start with these spark plugs, a hot engine would generally not start. Spark plugs test report indicated the following:

Top Cylinder Spark Plugs (type REM 38E):

1 Cylinder spark plug: Intermittent, gap Over 0.022".

2 " " " : Very weak, gap Over 0.022".

3 " " " : Very weak and intermittent, gap Over 0.022".

4 " " " : Dead, gap Over 0.022".

Bottom Cylinder spark Plugs (type REM 37 BY):

1 Cylinder bottom spark plug: Intermittent, gap Over 0.022".

2 " " " " : Good, gap Over 0.022".

3 " " " " : Dead, gap Over 0.022".

4 " " " " : Weak, gap Over 0.022".

The spark plugs were found lacking in maintenance, required cleaning and adjustment of gaps were the remarks inscribed at the end of the test report.

2.14 Engine Failure

Instructor Pilot's statement and interview revealed that he was teaching his student how to lean mixture during cruise at 6500 feet. On the second leg of the navigation, once the aircraft descended to 5500 feet, with the mixture lever still in the lean position, the air-fuel mixture became leaner. This caused the RPM to fluctuate. Seeing the RPM fluctuating and not finding a reason for it, the instructor decided to return to Walton. Once he decided to return to Walton, the aircraft descended to 3500 feet. It was during this descent that he found his RPM depleting, culminating in engine failure. There is no ambiguity as to the fact that the instructor pilot was demonstrating to the student how the mixture is to be leaned during cruise. The student had the controls when the aircraft was to descend to 5500 feet from 6500 feet as per the route requirement. Once the student started descending, he did not put the mixture lever to rich, which is evident from the questions / answers of the pilot and the student. As he descended, the air-fuel mixture became leaner (more air entering the cylinder with fuel quantity remaining the same). A leaner mixture caused the engine RPM to fluctuate – it was actually on its way to an engine failure unless fuel quantity for the amount of air entering the carburetor was increased. It required mixture lever to be pushed all the way forward. This was not done. Since the height at which they were to go back was 3500 feet, the descent caused the engine RPM to deplete further and the engine eventually quit. Once the engine failed, it could not be restarted because of the poor performance of the spark plugs. Moreover, hot engine with a hot induction manifold caused evaporation, which reduced the quantity of air fuel mixture inside the cylinders.

The engine, therefore, flamed out due to fuel starvation caused by the lean mixture getting leaner because of a descent without moving the mixture lever to rich position.

2.15 Role of Airworthiness Field Office Lahore

2.15.1 Immediately after the information of AP-BAH forced landing, President Safety and Investigation Board (PSIB) was in contact with the Acting Director Airworthiness (A/DAW).

Besides other instructions PSIB emphasized that the engine must not be started till the cause of its failure in the air was determined. The trade of the Airworthiness Surveyor at Lahore was Avionics. Since he was not an Aerospace Engineer, he needed to act on the instructions of the PSIB, who knew that starting up an engine would entail loss of valuable evidence that was required to establish the cause of the engine failure. The inspector, however, ordered the engine to be started after taking the fuel / oil samples from the aircraft. This was not only in violation of a generally known fact of not starting an engine that has flamed out in air unless the reason for the failure is established but also in violation of instructions by President SIB to the contrary. The airworthiness staff has probably never carried out any 'sampling' of LFC. Had a periodic look been taken at the plugs, other than inspecting paper entries, things may have been corrected. The poor maintenance of sparks plugs is as bad a negligence on the part of the Airworthiness Inspector as it is on the engineer department of LFC. While going into the systemic reasons, it was found that the Airworthiness Surveyor at Lahore had never stayed under a senior supervisor in the Airworthiness Headquarters but went on to assignments in Lahore for inadequately explained reasons. Besides maintenance supervision, an important task of airworthiness surveyors is technical investigation of aircraft as and when an accident or an incident occurs. It is imperative, therefore, that all new inductees are placed under the DAW who may subject them to a defined OJT syllabus before placing them under the Controllers of Airworthiness North or South.

- 2.15.2 There was no written program or timetable found for carrying out spot/random checks of general aviation Companies with the Airworthiness. Such random checks and a report on the results of these random checks sent to DAW with a copy to PSIB for safety monitoring purpose. This practice is likely to point out flawed practices or incorrect procedures being followed in the general

aviation before they can cause a mishap. Due to lack of monitoring unsafe practices could some times creep in the systems of any organization unchecked. Airworthiness Inspectors assume greater importance in correcting / reporting such malpractices. If this is not done the process of improvement is likely to suffer. Indifferent attitude towards flight safety from both aspects i.e Operations and Maintenance needs to be addressed at the highest level. Since less experienced and under-training aviators fly with flying club monitoring their maintenance practices assume greater importance. Random checking must, therefore, be enforced and reviewed each year.

2.16 Oil and Fuel Test Reports

Fuel and oil samples were tested at the Inspectorate of Army Stores & Clothing, Karachi. Their reports are attached at Annex 'F':

2.16.1 Fuel Sample 'A' (Annex 'F1'). The fuel sample which was taken from the strainer a few hours after the forced landing indicated a higher lead quantity, which would result in engine knocking as per the experts verbal explanation of the lead quantity found in the sample. The fuel sample 'A' failed in TETRAETHYL lead test because of high lead quantity in the sample. The sample was also found with slight sediments.

2.16.2 Fuel Sample 'B' (Annex 'F-2'). This sample was taken from the left tank of the aircraft approximately 24 hours after the forced landing. This sample indicates two failures. Firstly, higher recovery at 10%, which implies that the fuel contained a higher contamination level than is allowed by the specified limits. Secondly, Existent Gum mg / 100 ml was higher than the maximum allowed specified limits. This implies that the fuel could choke the fuel filters and fuel starvation or vapor lock could result.

2.16.3 Oil sample. The oil sample displayed no abnormality in the tests performed on it.

3. Conclusion

3.1 Findings

- 3.1.1 Lahore Flying Club (LFC) detailed AP-BAH on a cross-country training navigation.
- 3.1.2 C of A of the aircraft was carried out and the aircraft declared airworthy on 25 February 2004 (20 days before the incident).
- 3.1.3 The trade of the Airworthiness surveyor, who signed of the C of A was Avionics.
- 3.1.4 The Surveyor had not attended any OJT after joining the Airworthiness Department.
- 3.1.5 The instructor was authorized and had the requisite qualifications to under take a training mission with a student.
- 3.1.6 The instructor's total flying experience was 418 hours with 332 hours as PIC.
- 3.1.7 The aircraft was on an authorized training navigation.
- 3.1.8 Mixture lever had been set to lean-mixture configuration at 6500 feet.
- 3.1.9 A descend to 5500 feet, maintaining the same lean mixture setting, caused an engine RPM fluctuation.
- 3.1.10 A further descend to 3500 feet caused the engine to quit.
- 3.1.11 The pilot had no answer as to why he descended with a troubled engine.
- 3.1.12 Re-light attempts failed to start the engine.
- 3.1.13 A safe forced landing was performed about 35/36 NM West of Lahore.
- 3.1.14 Two types of spark plugs were used. Only one plug had a 'good' spark, the rest were either dead or very weak or intermittent.

- 3.1.15 All spark plugs had gaps wider than 0.022" whereas the manufacturer's recommendation is 0.016 to 0.021".
- 3.1.16 None of the spark plugs removed from AP-BAH looked 5 days old. The condition and spanner marks were indicative of prolonged usage.
- 3.1.17 Eight spark plugs of type REM 37 BY were issued for installation in AP-BAH on 20 June 2003.
- 3.1.18 Another four spark plugs type REM 37 BY were issued against AP-BAH on 10 March 2004 i.e five days before the incident.
- 3.1.19 All twelve spark plugs issued for AP-BAH by the club were type REM 37 BY whereas the plugs removed from the engine were a mix of type REM 37 BY and REM 38E. No record of issue of type REM 38E was available.
- 3.1.20 The condition of the spark plugs removed from the engine and the spanner marks visible on their bodies were indicative of prolonged usage.
- 3.1.21 None of the spark plugs displayed a condition that could be adjudged as being installed only five days prior to the incident.
- 3.1.22 The airworthiness representative who reached the site along with CE, LFC got the engine started without a thorough inspection and without establishing the possible cause(s) of the engine failure, despite clear instruction of the PSIB to the contrary.
- 3.1.23 The Airworthiness Surveyor who inspected the engine and ordered its start up in the field, in violation of instructions of the PSIB, was from the Avionics trade. He also lacked Aerospace experience and had not been subjected to any OJT after joining the Airworthiness Department.
- 3.1.24 The practice of OJT in Airworthiness for new inductees is not in vogue.

3.1.25 No record of plugs change/repairs is required by Airworthiness and non is kept.

3.1.26 Two types of spark plugs were used on the same engine simultaneously contrary to the manufacturer's recommendations. This was being done on the basis of 'personal judgement and experience' of the Chief Engineer, LFC.

3.1.27 Fuel report indicted a higher existent gum per 100 ml, which could cause choking of fuel filters in the long run.

3.2 **Cause**

3.2.1 The engine flamed out due to fuel starvation, caused by a descent with lean mixture setting.

3.3 **Contributory Factors**

3.3.1 Less than adequate experience of the instructor pilot to identify the cause of RPM depletion leading to an eventual engine failure.

3.3.2 Poor ignition due to inappropriate spark plugs / spark plug condition, which prevented a re-light.

4 **Recommendations**

4.1 Airworthiness should ensure a more thorough C of A Inspection by appropriate Airworthiness Surveyors whose trade and experience should be commensurate with the task at hand.

4.2 Airworthiness may like to look at the negligent and irresponsible act of Engineering Department LFC, who failed to see that serviceable, clean and appropriately gapped plugs were installed on AP-BAH in line with para 3.5 of Airworthiness Notice # 19, Issue # 1, dated 21 March 2000.

4.3 Inappropriate action of Airworthiness Surveyor, who started the engine in violation of P SIB's briefing to him (on an earlier incident and his message through Acting Director Airworthiness for this incident) be looked into by Director Airworthiness.

- 4.4 All fresh graduates inducted in airworthiness as inspectors / supervisors may be given mandatory OJT under the direct supervision of an experienced inspector in the Airworthiness HQ, which must be monitored by the DAW before posting these inspectors to the field offices. Since this has not been done in the past all fresh graduates inducted earlier and sent out to field offices must be posted back to Karachi for the OJT described above.
- 4.5 Pilots, especially instructor pilots, may be reminded periodically by Flight Standards Directorate of engine failure due to descend with lean mixture setting
- 4.6 Random checks by Airworthiness and Flight Standards be carried out more frequently as per the existing Air Navigation Orders and relevant CAADs.