FINAL INVESTIGATION REPORT

SERIOUS INCIDENT OF M/S AIRBORNE AVIATION CESSNA-152 AIRCRAFT REG NO. AP-BJW AT MANDI BHAOUDDIN ON 5TH MARCH, 2018

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Synopsis

The serious incident was reported to Safety Investigation Board (SIB), Pakistan by the Director Airborne Aviation through telephone and later Incident Occurrence Report of Pakistan Civil Aviation Authority dated 06th March, 2018 **(Appendix 'A')**. The incident was notified in accordance with ICAO Annex-13 **(Appendix 'B')**. Aviation Division, Government of Pakistan issued Memorandum vide letter No. HQCAA/1901/407/SIB dated 19 March, 2018 **(Appendix 'C')** authorizing SIB to investigate the serious incident. The aircraft was on a routine training flight and experienced engine partial power loss after approximately two hours of flight. The Instructor Pilot tried to recover the engine by recommended procedure but engine did not develop sufficient power required to sustain flight. Analyzing the emergency situation, the Instructor Pilot successfully landed the aircraft in an abandoned strip located within Pakistan Rangers Training Academy, Mandi Bhaouddin. There was no injury to onboard pilots and no damage to the aircraft.

1. FACTUAL INFORMATION

1.1. **History of the Flight.** The Instructor Pilot (IP) and Student Pilot (SP) were scheduled to fly training navigation flight for SP's final PPL Check. The flight took off from Walton airport and continued as per the Flight Plan. Around 1145 (PST) at 7000 feet AMSL, while leaning the mixture, the engine RPM started dropping. Instructor Pilot immediately pushed the mixture lever to full Rich Position, advanced throttle lever to full and selected Carburettor ON. The RPM started to rise but did not go beyond 1700 RPM. The Instructor Pilot analysed that the flight was not sustainable and decided to land at an abandoned landing strip located at Mandi Bhaouddin while attempting to recover the engine. A successful landing was made through Simulated Flameout Orbit (SFO) procedure. The personnel onboard remained unhurt and no damage occurred to the aircraft.

1.2. **Injuries to Persons**. There were no injuries to onboard Instructor and Student Pilots as a result of this serious incident.

1.3. **Damage to Aircraft**. There was no damage to the aircraft during the entire sequence of events till safe landing and aircraft final stop.

1.4. **Other Damages**. No other damage was observed to any person, property or equipment on ground as result of the subject serious incident.

1.5. **Personnel Information**. The flight carried 02 souls onboard which included 01 Instructor Pilot (IP) along with one Student Pilot (SP) and one SP as passenger. The details of cockpit crew are as under :-

(a) Instructor Pilot

- Date of Birth : 12th May, 1990
- CPL No : 3084 (A)
- Total Flying Experience : 4307:25 Hrs
- Simulator / Link Hrs : Nil
- Instructional Flying Hrs : 1693:00 Hrs

(b) Student Pilot:

- Date of Birth : 21st December, 1988
- Total Flying Experience (All on Cessna aeroplane) : 190:45 hrs

1.5.1. The cockpit crew was fit to undertake the flight and they had valid licenses and medical fitness certificates. CAA Pakistan approved rules and regulations in respect of flight duty time limitation (FDTL) were adhered to. Therefore, the cockpit crew of mishap aircraft (MA) was not observed to be exposed to any undesired stress / fatigue prior to flight as a result of FDTL violation.

1.6. **Aircraft Information.**

Aircraft Make & Model	Cessna-152
Registration Marking	AP-BJW
Manufacturer Serial No.	15283899
Year of Manufacture	1980
C of A (S No. expiry date)	14-12-2018
Maintenance review prior to 05-03-2018 (date, hrs, cycles, expiry date)	Issued on 16466:15 15-12-2017, Expiry 14-06-2018
Daily inspection prior to 05-03-2018 occurrence (date, location)	05-03-2018
Transit check prior to 05-03-2018 occurrence (date, location)	N/A
Total Aircraft Hours as on 05-03-2018 (prior to occurrence)	16749:40
Total aircraft cycles as on 05-03-2018 (prior to occurrence)	N/A
Total Landings as on 05-03-2018 (prior to occurrence)	N/A
Last Check-C (type, date, hrs, cycles, agency performed & location) prior to occurrence	CHK-III, 27-02-2018, 16716:55,Airborne Aviation Walton
Last Check-A (type, date, hrs, cycles, agency performed & location) prior to Occurrence	N/A

1.6.1. **Engine Information**

Part No.	0-235L2C
S No / Identification	L-13986-15
Manufacturer's Details	Lycoming
Time Since New (TSN) / CSN	--
Time Since Installed	916:20
Next Overhaul Due at TSN / CSN	2400:00

1.6.1.1. Details of last 05 scheduled / un-scheduled maintenance performed on this engine along with dates in the following format :-

S No.	Date / Location	Details of Sch / Un-sch maintenance	Hrs Flown till 05-03-2018
1	27-02-18	CHK-III Scheduled	17:15
2	12-02-18	CHK-I Scheduled	60:45
3	29-01-18	CHK-II Scheduled	105:50
4	08-01-18	CHK-I Scheduled	152:45

1.7. **Metrological Information**. On 5th March, 2018 the weather at departure aerodrome, Walton was as follows :-

Visibility	Outlook	Wind	Clouds	Temp	QNH	RH
04 KM	Partly Cloudy	02007	4SCCU2AC	19/12	1018.3	73%

1.8. **Aids to Navigation**. Aircraft was equipped with serviceable ADF, VOR / DME for conduct of flight.

1.9. **Communications**. All communication services onboard the aircraft and on ground were serviceable at the time of occurrence.

1.10. **Aerodrome Information**. Not Applicable.

1.11. **Flight Data Recorders**. Cessna-152 aircraft was not equipped with flight data recorder.

1.12. **Wreckage and Impact Information**. Not Applicable.

1.13. **Medical and Pathological Information**. Not Applicable.

1.14. **Fire**. There were no signs of in-flight fire or post landing fire.

1.15. **Additional Information.**

1.15.1. **ATC Tape Extracts.** ATC Tower / Approach Radar Tape Extracts and recordings were retrieved and analysed.

1.15.2. **Crew Resource Management (CRM).** At the time of occurrence, Student Pilot was the Pilot Flying (PF) whereas Instructor Pilot was Pilot Monitoring (PM). Both the cockpit crew had valid CRM certification at the time of accident.

1.15.3. **Useful & Effective Investigation Techniques.** Standard investigation techniques were applied to find out the cause of occurrence.

2. ANALYSIS

2.1. Operational Analysis

2.1.1. The conduct of operational investigation and analyses were based on all available evidences like aircraft examination / analysis, witnesses statements, equipment, weather records, Radar / ATC Tower tape extracts, personnel records and other domains pertaining to the aircraft and cockpit crew. All available evidences were critically analysed in order to determine, their direct or indirect contribution into the accident or otherwise. The detailed investigation and analyses of various domains have been carried out which are appended below.

2.1.2. Both pilots were physically fit and possessed their valid medical fitness certificates. They were scheduled to fly a day in advance based on their availability and fitness.

2.1.3. Flight # AP-BJW was on a routine navigation training flight (PPL Check) of Airborne Aviation. The cockpit crew had planned route Lahore - Sialkot – Indek – Lahore, the log card is attached as **Appendix 'D'**. They had obtained the latest weather / forecast for the duration of flight and logged the flight plan. The flight involved navigation to different places in accordance with the training requirements so did the heights flown varied.

2.1.4. The aircraft took off from Walton aerodrome having an elevation of 700 feet and initially climbed to 1500 feet AMSL. After set course, the aircraft was cleared to climb to 6000' AMSL. At this height it flew for almost one hour thirty minutes following Lahore – Sialkot – Indek route during which mixture was adjusted to lean as per procedure given in the Pilot's Operating Handbook (POH). The flight during this period remained uneventful and its engine did not show any signs of malfunction.

2.1.5. During last leg of planned navigation, Indek – Lahore the planned height was 5500' AMSL whereas due to traffic it was cleared by Lahore radar to climb to 7000' AMSL and turn left on heading 090° to intercept route J-122.

2.1.6. The aircraft followed Lahore radar instructions and climbed to 7000' AMSL. On the day of occurrence dew point was reported as 12°C and temperature reported was 19°C. The normal temperature lapse rate is approximately 2 degrees / thousand feet. At the flown height of 6000' AMSL (Approximately 5000' AGL) the ambient temperature was 09°C which is below the dew point. At this time when the aeroplane further climbed to 7000 feet the temperature of surrounding air was approximately 07°C.

2.1.7. The fuel-icing conditions can occur at the point of entry close to the carburettor due to vaporization of fuel and condensation within the temperature range of +4°C to +27°C. Most likely, mild fuel icing had already taken place due to prolonged operations in environment where dew point was higher than ambient temperature. This condition aggravated when mixture leaning was done at 7000 feet due to

narrowed fuel passage because of carburettor icing. (The phenomenon is explained in detail in succeeding paragraphs 2.1.12)

2.1.8. Carburettor Icing is a common phenomenon at higher altitude due to low temperatures and venturi effect created at the butterfly valve. As few minutes after levelling off, the SP as part of his training and procedure started to lean the mixture, during second and a half rotation of the mixture knob, the engine RPM started to drop to which instructor pilot immediately countered by advancing mixture to fully rich and the throttle to full open position. While trying to regain the RPM, IP attempted to take POH steps and pulled the Carburettor Heat (ON). Engine did show signs of picking up power however not to full gain. The IP judged that the level flight was not sustainable with the available power of 1500 / 1600 RPM, the decision was made to land at an appropriate field through Simulated Flameout Orbit (SFO). The nearest abandoned air strip was in Mandi Bhaouddin (which is located within Pakistan Rangers Academy premises) on which the aircraft was successfully and safely landed without any damage to aircraft or property.

2.1.9. After the incident the engine was thoroughly examined for any system malfunction however there was found none. This also further supported the idea of carburettor icing.

2.1.10. In order to probe why not engine regained power after applying carburettor heat and descending down to lower altitudes, the initial verbal statements of involved crew on the day of occurrence were taken into account. In their assessment, the crew took the onset of RPM drop as partial power loss and took actions accordingly. Carburettor icing was not a considered situation. There was an attempt to continuously move throttle and mixture levers in order to regain power till final approach for landing which did not let the engine stabilize. To counter the carburettor icing, only application of full carburettor heat along with descend to lower altitude was required by which the engine would have regained full power.

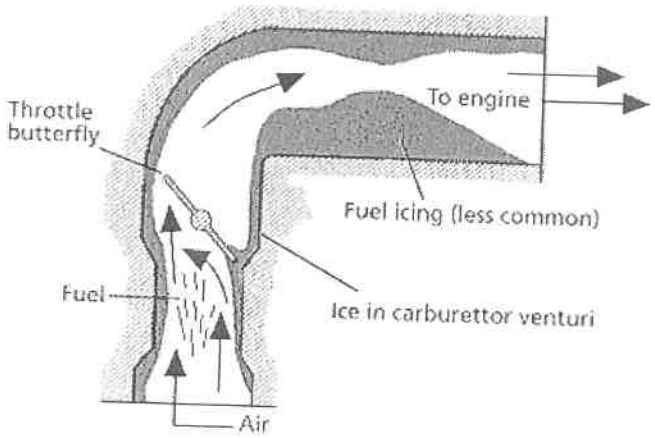
2.1.11. However, the flawless landing at an abandoned strip which had very little length available was done in a professional manner thereby saving aircraft, property on ground and personnel.

2.1.12. **Induction System Icing Phenomena.** Piston engine induction system icing, commonly, but not completely accurately, referred to as 'carburettor icing' may occur even on warm days, particularly if they are humid. It can be so severe that, unless correct action is taken, the engine may stop functioning in air. There are three mainly types of induction system icing :-

2.1.12.1. **Carburettor Icing.** The most common type of induction system icing is carburettor icing which is caused by a combination of the sudden temperature drop due to fuel vaporisation and the reduction in pressure at the carburettor venturi. The temperature reduction may be as much as 20°- 30° C and results in moisture in the induction air forming ice. The ice gradually builds up, constricting the venturi, and by upsetting the fuel/air ratio causes a progressive decrease in engine power. Engines which have a conventional float-type carburettor, as in this case are more prone to this type of icing.

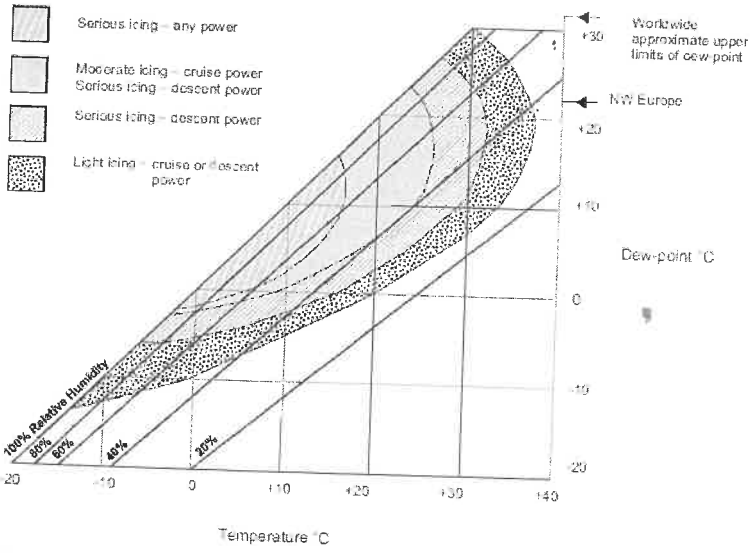
2.1.12.2. **Fuel Icing.** Fuel icing is the result of water, held in suspension in the fuel, precipitating and freezing in the induction piping, especially in the elbows formed by bends.

2.1.12.3. **Intake or Impact Ice.** Ice which builds up on air intakes, filters and carburettor heat or alternate air valves etc, is known as intake or impact ice. Impact ice can accumulate in snow, sleet or subzero – temperatures, cloud or in rain when the temperature of the rain or the aircraft is below 0°C. This type of icing affects fuel injection systems as well as carburettor systems.



BUILD UP OF ICING IN INDUCTION SYSTEM

2.1.13. **Atmospheric Conditions.** At cruise power, icing can occur at 20°C with a relative humidity of 60% or more. Ice accumulation is less on cold, dry winter days than on warm, humid summer days because the water vapor content of the air is lower. Thus, where high relative humidity and ambient temperatures of between -10°C and +25°C are common, pilots must be constantly alert to the possibility of icing and should take the necessary steps to prevent it.



CARBURETOR ICING IN FREE AIR

2.1.14. **Recognition / Symptoms of Icing.** With a fixed-pitch propeller, as in case of Cessna 152, a slight drop in RPM is the first sign which may indicate the onset of icing in the induction system. The loss of RPM may be gradual with no associated rough running. The usual reaction is to open the throttle slightly to restore the RPM and this action masks the early symptoms. As the icing increases there will be rough running, vibration and further RPM reduction. Thus the main detection instrument is the RPM gauge.

2.1.15. **Remedial Actions.** When the presence of induction system icing is suspected the HOT or alternate air ON position must be selected immediately. The recommended practice with most engines is to use full heat whenever carburetor heat is applied. The control should be selected fully to the HOT position. Partial heating can induce induction system icing because it may melt ice particles which would otherwise pass

into the engine without causing trouble, but not prevent the resultant mixture from freezing as it passes through the induction system.

2.2. Technical Analysis

2.2.1. After arrival at the site, a detailed visual inspection of the aircraft was carried out with the assistance of technicians from the Operator which revealed no apparent damage to the aircraft and its engine.

2.2.2. Keeping in view the safety aspects, the operator was advised to disassemble the aircraft, transport it by road to the Operator's maintenance facility at Lahore and then re-assemble.

2.2.3. Accordingly, the aircraft was shipped to Lahore and was re-assembled. The operator was advised to carry out a detailed technical investigation and inspection to find out any technical anomaly that may have been encountered by the aircraft or its engine before or after the incident. A report from the operator (**Appendix 'E'**) indicated that there was no technical malfunction that may have any impact towards the incident.

3. CONCLUSION

3.1. Operational Findings

3.1.1. Both pilots were physically fit and possessed their valid medical fitness certificates. They were scheduled to fly a day in advance based on their availability and fitness.

3.1.2. Flight # AP-BJW was on a routine navigation training flight (PPL Check) of Airborne Aviation.

3.1.3. The cockpit crew had planned route Lahore - Sialkot – Indek – Lahore, the log card is attached as **Appendix 'D'**.

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3.1.16. However, the flawless landing at an abandoned strip which had very little ground available was done in a professional manner thereby saving aircraft, property on ground and personnel.

3.2. **Technical Findings.**

3.2.1. Visual inspection of the aircraft at the site revealed no anomaly with the aircraft or its engine.

3.2.2. A detailed technical investigation conducted by the operator revealed that there was no technical malfunction by the aircraft or its engine which could have any contribution towards the reported incident.

3.3. **Cause of Occurrence.**

3.3.1. During the course of investigation, carburettor icing was ascertained as the cause of occurrence.

4. SAFETY RECOMMENDATIONS

4.1. Chief Flying Instructor (CFI) Airborne Aviation is to ensure that weather condition is taken into account thoroughly while planning navigation / cross country flights.

4.2. Chief Flying Instructor (CFI) Airborne Aviation and all General Aviation aircraft Operators to conduct lecture for Instructor and Student Pilots on Aircraft and Carburettor icing.

4.3. Aircraft and Carburettor icing must be included in the ground training of all aircrew of General Aviation flying institutes.