सत्यमेव जयते

Final Report on Accident involving Tecnam P2006T aircraft VT-VDB belonging to M/s FSTC Flying School Pvt. Ltd. at Bhiwani Airfield on 12/05/2022

FORWORD

In accordance with Annex13 to the Convention on International Civil Aviation Organization (ICAO) and Rule 3 of Aircraft (Investigation of Accidents and Incidents), Rules 2017, the sole objective of the investigation of an Accident/Incident shall be the prevention of accidents and incidents and not to apportion blame or liability. The investigation conducted in accordance with the provisions of the above said rules shall be separate from any judicial or administrative proceedings to apportion blame or liability.

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of various components. Consequently, the use of this report for any purpose other than for the prevention of future accidents or incidents could lead to erroneous interpretations.

ABBREVIATIONS

AAIB	Aircraft Accident Investigation Bureau, India
Accrep	Accredited Representative
AD	Airworthiness Directive
AFIR	Assistant Flight Instructor Rating
AFM	Aircraft Flight Manual
AGL	Above Ground Level
AKI	Anti Knock Index
AMO	Approved Maintenance Organisation
AMSL	Above Mean Sea Level
ARC	Airworthiness Review Certificate
ASTM	Advancing Standards Transforming Markets
ATC	Air Traffic Control
AUW	All Up Weight
AVGAS	Aviation Gasoline
BA	Breath Analyser
C.G	Centre of Gravity
C of A	Certificate of Airworthiness
C of R	Certificate of Registration
CAR	Civil Aviation Requirements
CPL	Commercial Pilot Licence
CVR	Cockpit Voice Recorder
DFDR	Digital Flight Data Recorder
DG	Director General
DGCA	Directorate General of Civil Aviation
EASA	European Union Aviation Safety Agency
ELT	Emergency Locator Transmitter
FAR	Federal Aviation Regulations
FIR	Flight Instructor Rating
F/O	First Officer
FRTOL	Flight Radio Telephone Operators License
FTO	Flight Training Organisation
Hrs.	Hours
HICA	Haryana Institute of Civil Aviation
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IMD	India Meteorological Department
IST	Indian Standard Time
Kt	Knots
kW	Killo Watt
LL	Low Lead
MEL	Minimum Equipment List
METAR	Meteorological Aerodrome Report
MFD	Multi Function Display
MLG	Main Landing Gear
MOGAS	Motor Gasoline
MTOW	Maximum Take Off Weight
NDB	Non-Directional Beacon
NLG	Nose Landing Gear

Nm	Nautical Miles
NTSB	National Transportation Safety Board
OEM	Original Equipment Manufacturer
PF	Pilot Flying
PIC	Pilot in Command
PM	Pilot Monitoring
RON	Research Octane Number
R/T	Radio Transmission
RVP	Reid Vapor Pressure
SB	Service Bulletin
TCDS	Type Certificate Data Sheet
TPM	Training and Procedures Manual
TSN	Time Since New
V_{MCA}	Minimum Control Speed
VHF	Very High Frequency
UTC	Coordinated Universal Time

Table of content

Final investigation report on Accident involving Tecnam P2006T aircraft VT-VDB belonging to M/s FSTC at Bhiwani airfield on 12th May 2022

1.	Aircraft Type	Tecnam P2006T
2.	Nationality	Indian
3.	Call Sign / Registration	VT-VDB
4.	Owner/ Operator	FSTC Flying School Pvt. Ltd.
5.	No. of Persons on board	02 (1 Flight Instructor, 01 Student Pilot)
6.	Date & Time of Accident	12 May 2022 at 0918 UTC
7.	Place of Accident	Bhiwani Airfield
8.	Accident Site (Location)	440 m from runway end inside Bhiwani airfield
9.	Last point of Departure	Bhiwani Airfield
10.	Intended place of Landing	Bhiwani Airfield
12.	Phase of Operation	Climb
13.	Occurrence category	SCF-PP
14.	Extent of Injuries	Nil

Unless otherwise indicated, all times in this report are stated in Co-ordinated Universal Time (UTC). The relationship between IST and UTC is: IST = UTC + 5½ hours.

SYNOPSIS

On 12 May 2022, a twin-engine Tecnam P2006T aircraft (VT-VDB) owned and operated by M/s FSTC Flying School Pvt. Ltd. while operating a training flight met with an accident at Choudhary Bansilal Airport, Bhiwani.

It was the second flying training exercise of the day. This training comprised of 06 circuit and landing exercises. After completion of the first circuit, the aircraft carried out the landing on runway 30. The touchdown was normal, and adequate distance was available to initiate a touch and go. After rolling for a few seconds on the runway, the aircraft took off and a positive rate of climb was achieved.

While aircraft was climbing, the crew observed roughness in the left engine, and subsequently loss in power accompanied by a change in engine sound. Thereafter, the crew followed the asymmetric handling procedures and tried to maintain the aircraft’s heading.

While the aircraft was still in its climb phase, crew again felt roughness followed by a loss of power in the second engine. This time starboard engine showed symptoms of power loss. Thereafter, aircraft speed dropped and crew could not maintain the desired climb. Subsequently, crew had decided to perform the forced landing and eventually managed to land the aircraft within the airport premises. However, during forced landing aircraft suffered substantial damage.

The occurrence was classified as an “Accident” in accordance with the Aircraft (Investigation of Accidents and Incidents) Rules, 2017. DG, AAIB ordered an investigation into the occurrence vide order no INV: 11011/7/2022-AAIB, dated 17th May 2022 to investigate the cause(s) of the Accident.

Initial notification of the occurrence was sent to concerned states along with ICAO as per the requirement of ICAO Annex 13 and state(s) appointed Accredited Representative to participate in the investigation.

Unless otherwise indicated, recommendations in this report are addressed to the regulatory authorities of the State having the responsibility for the matters with which the recommendation is concerned. It is for those authorities to decide what action is taken.

1. Factual Information

1.1 History of Flight

On 12 May 2022, the company's engineering staff reported at the Bhiwani airfield at 0200 UTC to inspect and prepare the aircraft for training flights. Before releasing the aircraft, it was ensured by the engineering team that engine coolant and engine oil was well within the limits.

The Flight instructor reported at flying training institute at around 0230 UTC and subsequently underwent Breath Analyser examination at approximately 0256 UTC. According to the instructor, prior to operating the first flight of the day, pre-flight inspection of VT-VDB (P2006T) was carried out, and the aircraft was found serviceable.

<u>Previous Sorties</u>

Prior to the accident sortie, Instructor had completed dual flying sortie where other trainee of the FTO got training on 'emergency handling and landing procedures' on this multiengine aircraft VT-VDB. No technical snag or engine related abnormality was reported during these flying sorties. Further, Flight Authorisation book revealed that training was conducted for a duration of 01 hour 30 minutes before the last sortie concluded at 0715 UTC.

<u>Accident Sortie</u>

The Student Pilot reported at the base at around 0230 UTC and meanwhile, when other training flights were in progress, trainee completed his BA test at around 0557 UTC.

The accident flight was the 2nd sortie of the day, comprising of 06 circuit and landing exercises. As per the company SOP, prior to operating the aircraft, student pilot carried out pre-flight walk around checks and observed 155 litres of fuel onboard using the dipstick. Subsequently, load and trim sheet was prepared by the student pilot for the sortie, which was approved by the instructor. According to the statement of student pilot, after both engines started, oil & coolant temperature were also found within the limits. Other parameters observed were also found in green. Thereafter, run up check for both engines was carried out and, along with other engine parameters, rpm drop was also found satisfactory. In addition to this, the propeller cycling and Mag drop were also found within range. Once it was confirmed by crew that all relevant parameters are within range, crew took clearance from local ATC. The aircraft was cleared for a left-hand circuit pattern for runway 30.

After completing all the necessary checks, at approximately 0905 UTC, aircraft taxied out and lined up on runway 30. After clearance from tower, aircraft took off from runway 30 for its first circuit and landing exercise. According to Student Pilot, after getting airborne, engine parameters were observed and all were in green ARC (within limits). Further, according to ATC personnel statement, weather was conducive to undertake the training flight as the visibility was above minima and no clouds were reported around.

During the training flight, instructor had demonstrated all the relevant checks to the student pilot. After completion of downwind and base leg, landing gears were extended. According to Student Pilot, all checks completed as per the checklist and after ensuring all three green (landing gear extended), wing flaps were extended to configure the aircraft for landing. Thereafter, crew requested a touch and go. But ATC informed crew to give a call once aircraft align on finals. Aircraft then reported finals and confirmed three greens to land, consequently it was cleared for a touch and go exercise.

According to ATC personnel statement, at 0917 UTC, aircraft made a successful touchdown where sufficient length of runway was available to execute a touch and go exercise. After touchdown, aircraft rolled for approximately 5 seconds and covered a distance of around 100 feet. According to the statement of Student Pilot, while the aircraft was still in rolling phase, instructor took over the controls and configured the aircraft for take-off, therefore, flaps were retracted and throttle was advanced to full power position.

Soon after, the aircraft attained a speed of 64 knots (V_R) and lifted off approximately halfway down the runway. According to the Instructor, after ensuring a positive rate of climb, the landing gear brakes were applied to stop wheel rotation. However, as the crew was about to retract the gear, they experienced roughness in the left engine and subsequently observed a loss of power.

Crew further claimed that change in engine sound was also noted following left engine failure. Thereafter, instructor immediately took over the controls. However, manifold pressure started decreasing and aircraft yawed to the left.

Since the right engine was live, asymmetric handling procedure was followed, and accordingly right rudder was applied to control the aircraft's heading, and simultaneously banked towards the live engine to maintain directional control.

While the aircraft was approximately 100 feet AGL and speed was around 84 knots, both instructor and student pilot again experienced roughness. This time it was felt towards right side. Once the crew felt loss of power in second engine i.e right engine, instantaneously right rudder pressure was eased off to bring the aircraft in wings level flight. While the crew were engaged in controlling the aircraft direction and attitude, meanwhile aircraft speed dropped to around 55 knots. Thereafter, aircraft began to sink, and while it was at approximately 20 feet AGL, propeller of the left engine completely stopped rotating. Subsequently, aircraft swung to the left. Crew decided for forced landing. During landing, aircraft collided with ground ahead of departing runway and came to rest inside the airfield premises but very close to boundary wall.

According to the instructor's statement, he observed fuel smell as well as heard the sound of fuel leak, therefore, the student pilot was instructed to evacuate the aircraft immediately. The student pilot tried to open the main door, but it could not be opened as it was stuck. Meanwhile, aircraft's electrical system was shut down and fuel knob was closed by the instructor. Since the main door, located in front, could not be opened, the student tried the rear door to escape from the aircraft. Once the student pilot was able to manage opening of rear door, both instructor and student safely evacuated from rear.

Meanwhile, a technician raised the alarm in the hangar upon witnessing this forced landing. FTO's Operations/Admin officer headed to the crash site to rescue the crew. Upon reaching at site, the rescue team observed that both crew members had already evacuated the aircraft and moved away at a safe distance from the wreckage. Thereafter, Operation manager ensured that all electrical switches were off before wreckage was secured at the crash site.

1.2 Injuries to Persons

Injuries	Instructor	Trainee	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
~~Minor~~/None	01	01	Nil

1.3 Damage to the Aircraft

The aircraft was substantially damaged.

1.4 Other Damages

Nil

1.5 Personal information

1.5.1 Flight Instructor

Nationality	Indian
Age	34 years
Date of Joining to the Organization	01 Jan 2022
License	CPL
Date of Issue	28 Dec 2008
Valid up to	20 Dec 2026
Category	Aeroplane
Date of Class I Med. Exam.	11 Dec 2021
Class I Medical Valid up to	25 Dec 2022
Date of issue FRTOL License	26 Dec 2008
FRTO License Valid up to	18 Dec 2026
Endorsements as PIC	C-152, C-172, Tecnam P2006T, Tecnam P2008JC
Total flying experience	1588:52 Hrs.
Total flying experience on type	28:20 Hrs.
Last Flown on type	11 May 22 Tecnam P2006T
Total flying experience during last1 year	444.35 Hrs.
Total flying experience during last 6 months	320:20 Hrs.
Total flying experience during last 30 days	71:25 Hrs.
Total flying experience during last 07 days	26:15 Hrs.
Total flying experience during last 24 Hours	04:40 Hrs.
Rest period before flight	13:00 Hrs.
Whether involved in Accident/Incident earlier	Not involved in any accident or incident

1.5.1.1 Additional information- Flight Instructor

The Flight Instructor initially joined the Gujarat Flying Club for his ab-initio training in the year 2005. After completion of mere 03:15 Hrs. of training flight at Gujarat Flying Club, instructor left the training institute and went abroad to complete his remaining flying training at a foreign FTO. After completing his flying training abroad, the instructor underwent checks at Gujarat Flying Club required for issuance of CPL License by Indian regulator, i.e. DGCA. Once the instructed cleared all checks and met the requirements of DGCA, he was awarded CPL in 2008.

Later, in the year 2018, the instructor started his career in aviation as Assistant Flight Instructor at Gujarat Flying Club. After clearing viva and subsequent checks, AFIR (A) was issued by the DGCA on 1st May 2019.

FIR(A) check was carried out in February 2020 at Gujarat Flying Club following the passing of viva exam held by DGCA. Upon clearing all relevant requirements, the FIR(A) was issued on 5th October 2020.

Further, records revealed that the instructor did not clear the authorization check conducted at Aligarh in March 2021. Following a three-month cooling period, a second attempt was made in July 2021, which the instructor passed successfully. Consequently, the instructor was appointed as a Flight Instructor at the Gujarat Flying Club after successfully releasing his first five solo training flights

While serving at the previous FTO, the Instructor was also entrusted with the additional duty of Chief Ground Instructor. Further, it has been observed that flying training was primarily conducted on Cessna 152 and Cessna 172 aircraft.

On 1st January 2022, the instructor joined the FSTC Flying School Pvt. Ltd, Bhiwani in the capacity of a Flight Instructor following endorsement of Tecnam P2008JC & Tecnam P2006T aircraft types on his license. Thereafter, the instructor completed his Right-Hand seat instructional training flying of 05:00 hours with a DGCA approved examiner at Patiala Aviation Club and obtained clearance on Tecnam P2006T in February 2022.

Based on a review of the instructor's work and rest schedules, fatigue was not considered to be a factor in the accident.

The total experience of the instructor on multi-engine aircraft is presented below:

MULTI ENGINE FLYING EXPERIENCE OF PIC/Instructor			
AIRCRAFT TYPE	**DAY**	**NIGHT**	**INSTRUCTIONAL**
BE-76	32:54 hrs.	5:06 hrs.	Nil
TECNAM P2006T	35:40 hrs.	7:00 hrs.	23:05 hrs.
TOTAL	68:34 hrs.	12:06 hrs.	23:05 hrs.
GRAND TOTAL	80:40 hrs.		

1.5.2 Student Pilot

Nationality	Indian
Age	20 years
Date of joining the Organization	03 May 2022
License	SPL
Date of Issue	03 Feb 2020
Valid up to	02 Feb 2025
Category	Aeroplane
Date of Class I Med. Exam.	23 Nov 2021

Class I Medical Valid up to	28 Nov 2022
Date of issue FRTOL License 11019	FTROL(R) 04/03/2020
FRTO License Valid up to	FRTOL(R) 03/03/2030
Endorsements as PIC	C-172R, Tecnam P2008JC, Tecnam P2006T
Total flying experience	182:35 hrs.
Total flying experience on type	01:15 hrs.
Last Flown on type	11 May 2022
Total flying experience during last 01 year	158:00 hrs.
Total flying experience during last 06 months	102:15 hrs.
Total flying experience during last 30 days	02:35 hrs.
Total flying experience during last 07 days	01:45 hrs.
Total flying experience during last 24 hours	00:40 hrs.
Rest period before flight	15:00 hrs.
Whether involved in Accident/Incident earlier	Not involved in any accident or incident

1.5.2.1 Additional information: Student Pilot

On 18th Jan 2021, Student pilot had enrolled in the SVKM NMIMS Academy of Aviation, Shirpur and commenced his first flight on Cessna 172R aircraft on 21st Jan 2021.

Later, the student pilot joined FSTC, Bhiwani, on 3rd May 2022 to complete his remaining 15:00 hours on multi-engine aircraft and 05:00 hours on the Tecnam P2008JC. Prior to joining FSTC, the student pilot had completed 180:00 hours of flying on the Cessna 172R at Shirpur, which included GFT (Day), GFT (Night), a 250-nautical-mile cross-country test by day, and a 120-nautical-mile cross-country test by night.

At FSTC, the student pilot flew 01:35 hours on Tecnam P2008JC and 01:15 hours on Multi Engine Aircraft (P2006T).

Scrutiny of the Flight Authorisation Book revealed that the Student Pilot had accumulated a total of 01 hour of flying experience on the Tecnam P2006T aircraft over the previous two days. During those two sorties, student pilot was primarily given training on ‘Air Experience’ on Tecnam P2006T aircraft.

1.6 Aircraft Information:

1.6.1 Tecnam P2006T

Tecnam P2006T is a twin-engine four-seat aircraft with high cantilevered wing and tricycle retractable landing gear. It is equipped with 2 Rotax 912S3 engines. The aircraft cockpit is a glass cockpit comprising of Garmin 950 System. According to the AFM, the allowable ambient temperature range set by the OEM for this aircraft is from -25 °C to +50 °C.

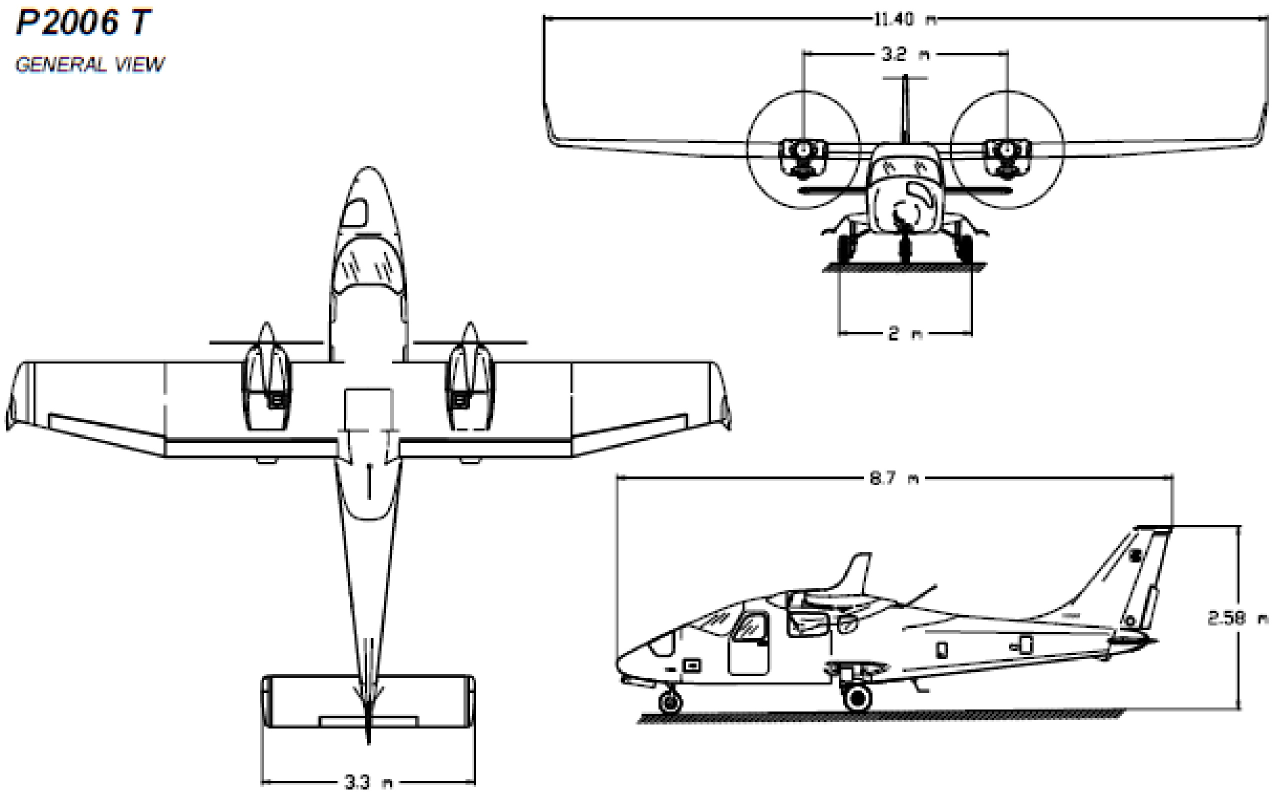


Figure 1: THREE-VIEW AND DIMENSIONS

Engine and propeller details specified by the OEM in the Tecnam P2006T AFM are outlined below:

ENGINE	
Manufacturer	Bombardier-Rotax GmbH
Model	912 S3
Certification basis	FAR 33 – Amendment 15
Type Certificate	EASA TCDS no. E.121 dated 1 April 2008
Engine type	4 cylinders horizontally opposed with 1352 c.c. of overall displacement, liquid cooled cylinder heads, ram-air cooled cylinders, two carburettors, integrated reduction gear box with torsional shock absorber and overload clutch.
Maximum power (at declared rpm)	73.5 kW (98.6 hp) @ 5800 rpm -5 minutes maximum. 69.0 kW (92.5 hp) @ 5500 rpm (continuous)

PROPELLER	
Manufacturer	MT Propeller
Type Certificate	LBA 32.130/086 (MTV-21 series)
Model	MTV-21-A-C-F/CF178-05
Blades/hub	2 wood/composite blades - aluminum hub
Diameter	1780 mm (no reduction allowed)
Type	Variable pitch – hydraulically controlled and fully featherable

The aircraft systems and components which are relevant to the investigation are elaborated below:

1. **Engine Cooling System:**

P2006T is equipped with two four-cylinder four-stroke Rotax 912S engines of 98hp (73kW) each, both rotating clockwise. These are partially cooled liquid, and they feature an integrated reduction gear driving constant speed propellers with pitch feathering devices.

The cooling system is designed for liquid cooling of the cylinders heads and ram-air cooling of the cylinders. The liquid system is a closed circuit with an overflow bottle and an expansion tank.

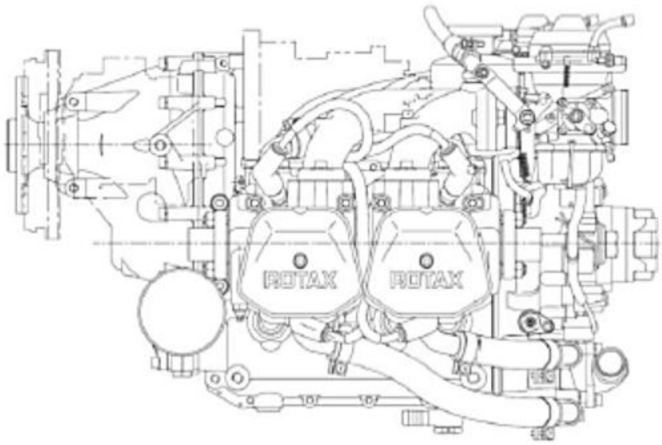


Fig 2: Rotax 912 S3 Engine

The coolant flow is forced by a water pump, driven from the camshaft, from the radiator to the cylinder heads. From the top of the cylinder heads the coolant passes on to the expansion tank (1). Since the standard location of the radiator (2) is below engine level, the expansion tank, located on top of the engine, allows for coolant expansion.

The expansion tank is closed by a pressure cap (3) fitted with pressure relief valve and return valve. At temperature rise and expansion of the coolant, the pressure relief valve opens, and the coolant will flow via a hose at atmospheric pressure to the transparent overflow bottle (4). Once cooled down, the coolant will be sucked back into the cooling circuit.

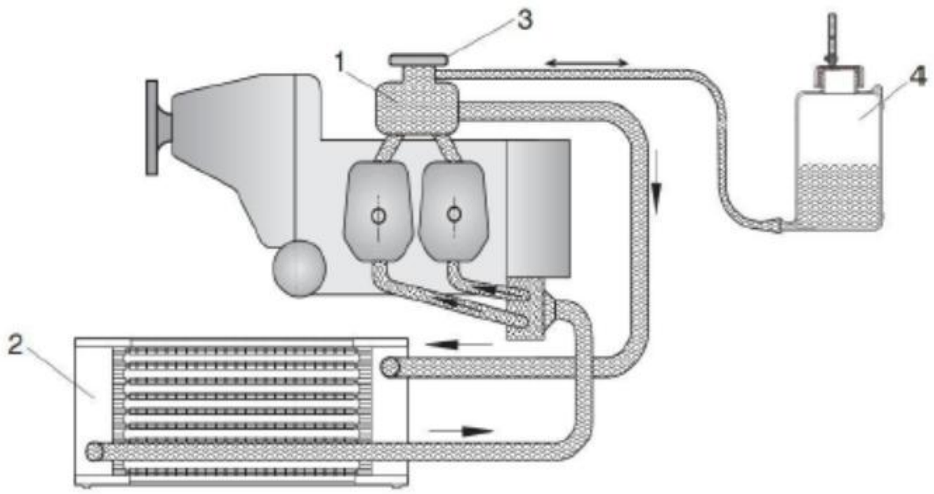


Fig 3: Liquid cooling system schematic

2. **Aircraft Fuel System:**

Approved Fuel	MOGAS **ASTM D4814*** MOGAS EN 228 Super/Super plus (min. RON 95) AVGAS 100 LL (ASTM D910)
Fuel tanks	Two integrated tanks (one in each wing) fitted with drainable sump and drain valve
Capacity of each wing tank	100 litres (26.42 US gallons)
Tanks overall capacity	200 litres (52.8 US gallons)

CAUTION: Prolonged use of Aviation Fuel Avgas 100 LL results in greater wear of valves seats and greater combustion deposits inside cylinders due to higher lead content. It is therefore suggested to avoid using this type of fuel unless strickly necessary. Make reference to Rotax Maintainence Manual which prescribes dedicated checks due to the prolonged use of Avgas.

ASTM D4814* specifies a wide range of parameters that automotive gasoline must meet to ensure proper engine performance and minimize emissions. These parameters include:

- Volatility: Regulated through Reid Vapor Pressure (RVP) to optimize engine starting, performance, and evaporation characteristics. Season-specific RVP limits are included to address differences in fuel behaviour in summer and winter.
- Distillation: Ensures consistent fuel vaporization, crucial for engine efficiency and emissions control.
- Octane rating: Sets the minimum anti-knock index (AKI) to prevent engine knocking under high compression.
- Sulphur content: Limits sulphur levels to reduce exhaust emissions and protect catalytic converters.
- Oxygenates: Allows for specified levels of ethanol and other oxygenates to improve combustion and meet renewable fuel standards.
- Gum content and corrosion: Tests for residues and the potential for metal corrosion to ensure long-term fuel system compatibility.

The standard also includes performance tests and classifications based on geographic and seasonal requirements. Compliance with ASTM D4814 ensures that gasoline performs reliably across a wide range of environmental conditions while meeting emission standards.

2.1 Description and Operation

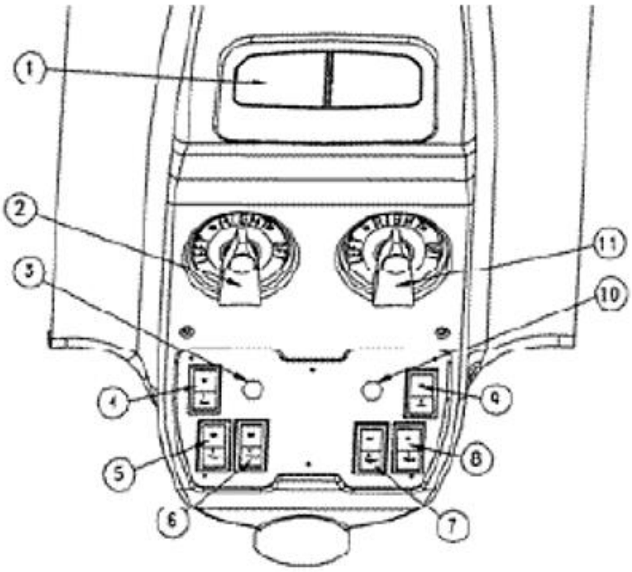
Fuel system consists of two integrated tanks inside the wing torque boxes and fitted with inspection doors. Each fuel tank is equipped with a vent valve (its outlet is located on the lower wing skin) and a sump fitted with a drain valve for water/moisture drainage purposes.

Fuel system is designed to supply fuel to the two reciprocating engines **Rotax 912S** with suitable fuel flow rate and pressure (two fuel lines, one for each engine) for the whole of certified flight envelope.

A multi-position fuel selector valve is located on the cabin over-head panel. Fuel feed is through an engine-driven mechanical pump (which is part of the engine) and also through an electric pump that supplies adequate engine feed in case of main pump failure.

In normal conditions, to supply fuel to engines, each engine pump sucks fuel from the related tank; cross feed is allowed by fuel valves located on the front spar and controlled by Bowden cables from the fuel selectors located on the cabin overhead panel.

Left fuel selector manages the left engine feeding, allowing fuel supply from the left fuel tank or from the right one (cross feed).



1. Cabin Light
2. LH Fuel Selector valve
3. LH Electric Starter
4. LH Electric Fuel Pump
5. LH Engine Ignition-1
6. LH Engine Ignition-2
7. RH Engine Ignition-1
8. RH Engine Ignition-2
9. RH Electric Fuel Pump
10. RH Electric Starter
11. RH Fuel Selector valve

Fig 4: Cabin over-head panel control Switches

Right fuel selector manages the right engine feeding, allowing fuel supply from the right fuel tank or from the left one (cross feed).

Each selector can be set in OFF position only pulling and simultaneously rotating the lever: this avoids an unintentional operation.

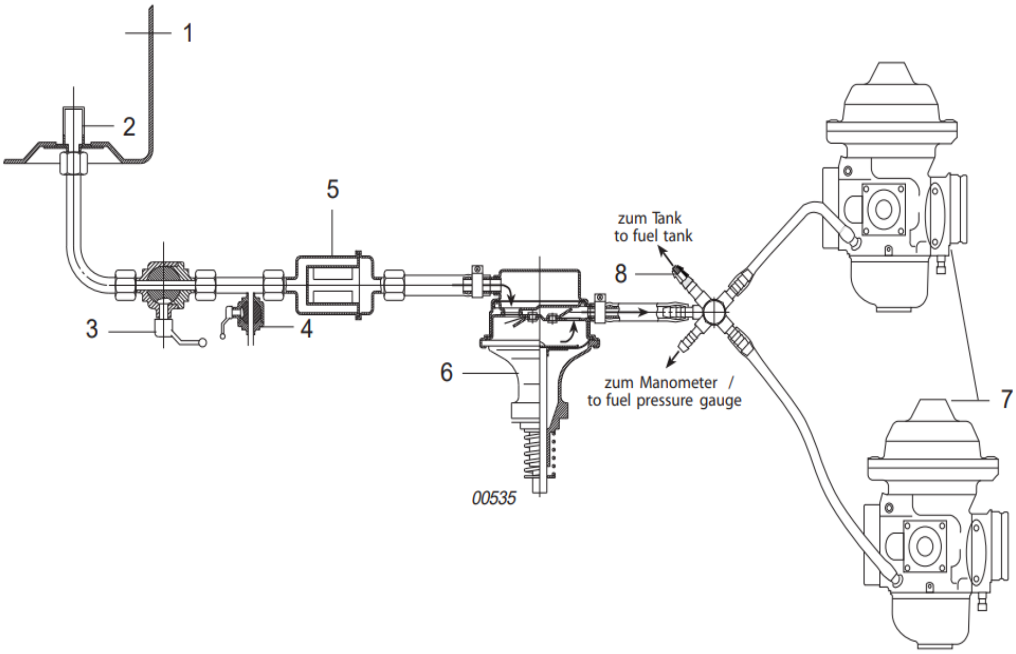


Fig 5: Fuel System Schematic

The fuel passes from the tank (1) with the coarse filter (2) via the fire cock (3), the water drain cock (4) and the fine filter (5) to the mechanical fuel pump (6). The latter then pumps the fuel to the two carburetors (7). The surplus fuel passes back to the tank or to the suction side of the fuel system via the return line (8).

◆ NOTE: The return line prevents malfunctions caused by the formation of vapor lock. The return line must be restricted to allow circulation of surplus fuel and air without losing pressure.

2.2 Fuel Distribution System

- Fuel is delivered to each engine via two independent fuel lines.
- Under normal operation, engine-driven mechanical pumps (one per engine) draw fuel from their respective tanks.
- In case of engine-driven pump failure, an electric emergency fuel pump (one per engine) ensures continued fuel delivery.

2.3 Fuel Cross-feed Capability

- Fuel selectors located on the cabin overhead panel allow for crossfeed operations.
- These selectors are mechanically linked via Bowden cables to fuel valves on the front spar.
  - The left fuel selector controls fuel supply to the left engine, enabling selection between the left or right tank.
  - The right fuel selector controls the right engine, with similar crossfeed capability.
- Each selector includes a safety lock: the OFF position can be selected only by pulling and rotating the lever simultaneously, preventing accidental shutdown.

3. Aircraft Doors System

The main door of the cabin is located forward on the left side of the fuselage while the emergency exit (passenger door) is located aft on the right side of the fuselage. In addition to two main doors, one ditching emergency exit is provided on the top of the cabin.

Being the main door located in correspondence of the propeller disc, its operation is limited to the engine shut-down condition. In fact, in order to prevent crew injuries, an electro-mechanical device locks the door latch when the left engine runs. A pressure switch senses engine oil pressure and allows for electrical supply to a solenoid which engages the door lock mechanism. This prevents the latch opening when the left engine runs but, if needed, the device can be also manually by-passed operating either from the door inside panel or from outside.

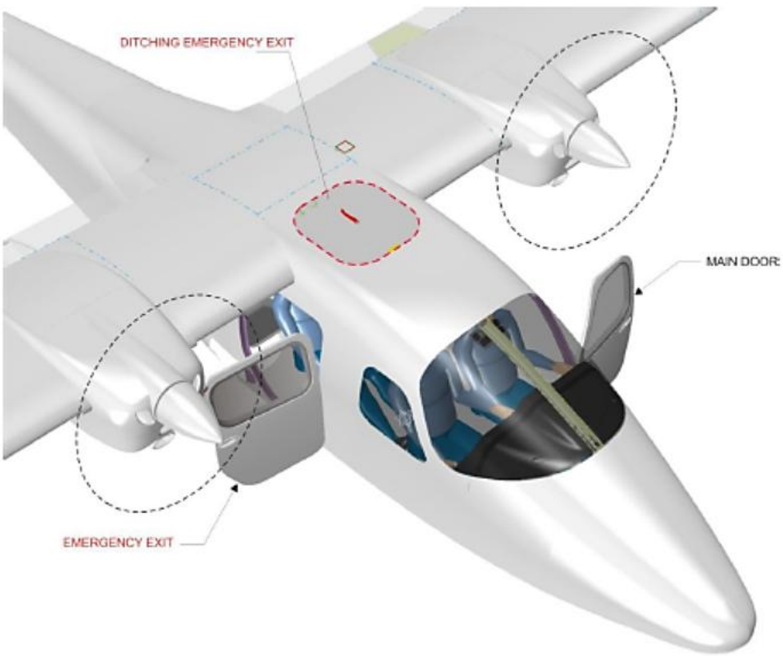


Fig 6: Different doors position on Tecnam P2006T

Instructions are mentioned on the placards near the by-pass lever, located in correspondence of the latch: to unlock, it is necessary to push and hold the red tab down, after that the door can be opened operating the handle.

After engine shut-down, the pressure drop can have a certain delay, preventing the door from being opened by normal means: do not force the handle but operate the override system above mentioned.

In any case, the electric lock becomes disengaged after a complete loss of electric power.

The emergency exit is fitted with the same safety device: in this case the pressure switch allowing for solenoid operation is activated from right engine oil pressure line.

The ditching emergency exit is manually operated by turning the handle and pushing outward the door.

4. Garmin System

The aircraft is equipped with Garmin 950 system. On Garmin 950 system, two SD card slots are provided on each display unit for capturing aircraft parameters. The location of these slots is depicted in Figure 7.

As per Garmin 950 Touch Pilot's Guide, it is recommended to maintain three SD cards for the 950 system. One SD card should be used exclusively for loading software, another SD card should be used exclusively for loading databases, and a third card should be used exclusively for flight purposes.

Fig 7: Aircraft's cockpit photo post-accident (Two upper SD card slots without memory cards)

Garmin Manual states that 'the flight data logging feature will automatically store critical flight and engine data on an SD card inserted into the top card slot of the MFD'. Further, it states that approximately 4000 flight hrs. can be recorded on the card.

After the crash, two SD cards removed from each bottom slot of Garmin units were handed over to the investigation team. The upper card slots of the display device did not contain any SD cards.

The raw files retrieved from those cards were shared with Accrep, nominated by the state of manufacturer of the Garmin System i.e NTSB. After analyzing the data, the Accrep confirmed that no operational parameters were recorded by none of the SD cards.

Since no SD card was installed inside the top slot of the MFD, no data logging was executed by the Garmin system. In this regard, the involved FTO had confirmed that since parameter recording was not mandatory under the DGCA regulations at the time of accident and the operator was also not aware of the functioning of the system, they inadvertently missed the opportunity to utilize the Garmin System and therefore, no mechanism was put in place to record the flight parameters and monitoring them for internal purpose.

Once the NTSB confirmed that none of the files contained any flight log data and the recovered files explicitly related to Garmin Navigation database, the investigation team had decided to send the units to NTSB facility for the retrieval of data from the residual memory of the units. Thereafter, both units were shipped to NTSB facility. Upon examination of these units, NTSB confirmed that no flight information could be recovered from the NVM of the Garmin units.

1.6.2 Aircraft Specific Information (VT-VDB)

Aircraft Model	Tecnam P2006T
Aircraft S. No. (MSN)	269
Year of Manufacture	2019
Name of Owner	FSTC Flying School Pvt. Ltd.
Certificate of Registration No. & issue date	No. 5245/2 issued on 17.09.2021
Airworthiness Review Certificate	Date of issue:08.10.2021 Date of Expiry:08.10.2022
Category	Normal
C of A validity/ Issue date	Subject to ARC validity/ Issued on 5.10.2020
ARC issued on	08 Oct 2021
ARC valid up to	08 Oct 2022
Maximum Takeoff weight	1230 Kgs
Date of Aircraft weighment	02 March 2020
Empty Weight	876 Kgs
Max Usable Fuel	197.40 Liter.
Total Aircraft Hours	615:35 Hrs.
Last major inspection	800 Hrs/3 years inspection on 20 April 2022
List of Repairs carried out after last major inspection till date of accident	Nil
Engine Type	Rotax 912 S3
Date of Manufacture	12.02.2019 (S/N: 9139073) & 11.02.2019 (S/N: 9139075)
Engine Sl. No.	9139073 (LH) & 9139075 (RH)
Last major inspection	A/F: 600 Hrs., Engines: 200 Hrs.

List of Repairs carried out after last major inspection till date of accident	NIL
Total Engine Hours/Cycles	615:35 Hrs. (TSN)
Propeller type	MTV 21 A-C-F/CF178-05
Propeller SL No.	190364 (LH) & 190376 (RH)
Total Propeller Hours	615:35 Hrs.
Aero mobile License (valid up to)	30 Sep 2024
AD, SB, Modification complied	Last applicable SB-912-074 was complied

According to the operator, all engineering and maintenance related activities were being carried out on the aircraft by its DGCA Approved Maintenance Organization (AMO). Maintenance was performed in compliance with approved maintenance programme, and Work orders dealing with modifications and repairs were prepared by FSTC AMO only.

Further, FTO carries out modifications recommended by manufacturer through Service Bulletins and other service data falling under the scope of approval. And, any other work that falls outside the class and rating of the scope of approval are subcontracted to other DGCA approved organizations.
Aircraft records revealed that it was certified, equipped and maintained in accordance with existing regulations and approved procedures. The most recent 50 hour and 100 hour inspections were completed on 08 Feb 2022 and 15 Dec 2021 respectively. The last SB 912-074 issued by the OEM on 3rd Dec 2020 was found to be complied by the operator. As mandated by this SB, Carburettor float was replaced with another float bearing No. 861189 on 21 Feb 2021.

1.7 Meteorological Information

Weather information was gathered by FTO usually through two systems, namely IMD website and the DAVIS VANTAGE equipment. In addition to this, it is a common practice in flying institutes to monitor weather through mobile app WINDY. Trainees primarily used this app for observing local weather and nearby stations.

The weather information (METAR) recorded at Bhiwani Airport on 12 May 2022 at 0900 UTC was: wind 320 degrees 07 knot, temperature **44** ºC, dew point 06 ºC, QNH 995 HPa, visibility 5000m and NOSIG (no significant change). However, the ambient temperature at Bhiwani airfield was recorded **46 °C** when measured on the Davis Vantage device immediately after the accident. Readings displayed on the device are shown in Fig 8.

Fig 8: Ambient Temperature recorded by the Device

1.8 Aids to Navigation

Bhiwani airfield with runway orientation 30/12 is an uncontrolled airfield, hence, no navigation aid is installed at the airfield.

1.9 Communication

A positive two-way communication was always maintained between ATC unit and involved aircraft. The aircraft was fitted with VHF radio set which catered for communication while flying. During circuit flying, student pilot was in two-way positive communication with local ATC, manned by FSTC personnel. However, no recording facility is available at Bhiwani ATC.

1.10 Aerodrome Information

Chaudhary Bansi Lal Airport, Bhiwani is an uncontrolled airport and its ICAO code is VIBW. This airfield is owned by Haryana Institute of Civil Aviation (HICA), the State Government of Haryana and leased to M/s FSTC for conducting Flying Training in accordance with FTO permit issued by DGCA.

The geographical co-ordinates of the aerodrome reference point are 28° 50’ 12” N & 76° 10’ 44” E. The elevation of the airfield is 225 m/738 feet (AMSL) and the runway orientation is 30/12.

1.11 Flight Recorders

No flight recorder (CVR/DFDR) was installed on the aircraft. DGCA’s regulations also do not mandate the same for the category of aircraft under CAR Section 2 Series I Part V.

1.12 Wreckage and Impact Information

The aircraft wreckage was found approximately 440 meters away from the runway end and 30 meters inside the perimeter wall of the airstrip. The aircraft suffered damages beyond economical repair. Damages observed on the aircraft was found in consistence with the aircraft profile at the time of collision on ground. During forced landing, aircraft was in a right bank and nose down attitude. The nose landing gear along with right landing gear was found collapsed whereas the left landing gear was found intact. Subsequent to collision with soft ground, aircraft’s left landing gear acted as a

Fig 9: Aircraft wreckage final position

pivot and consequently aircraft swung to 180 degrees before it settled at the final position. Since the aircraft did not accelerate after the impact, no ground marks showing forward movement was noticed at the accident site.

All major components of the aircraft were accounted for at the accident site. An examination of the wreckage revealed that both propellers were in the non-feathered position and the landing gear was extended at the time of impact.

Further, bottom section of the aircraft's nose area and windshield damaged subsequent to the impact with ground. In addition to this, substantial damage was observed on both wings, except to aircraft's empennage area. Left door was found intact, however the right door (emergency door) got detached from the holding points and found lying next to fuselage. The aircraft damage report is attached to this report as Annexure 'A'.

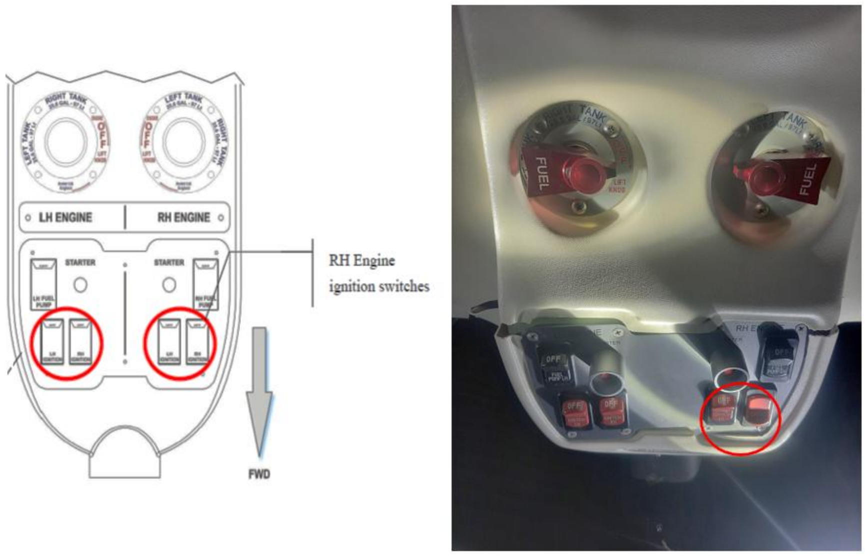


Fig 10: Positions of Switches on overhead panel

The position of different fuel switches located at overhead panel were recorded. The fuel selector knobs for both engines were at 'OFF' position. Fuel pumps of both left and right side were also at 'OFF' position. Both, left ignition switch and right ignition switch of the left engine were at 'OFF' position, however, the left ignition switch of right side was at 'OFF' position and the right ignition switch was at 'ON' position.

Later, both engines were examined at operator's facility itself, located at Bhiwani airstrip, which indicated that there was a high possibility that right engine was producing power while aircraft was coming for forced landing.

1.13 Medical and Pathological Information

The Instructor and the Student pilot reported at Bhiwani Airfield on their scheduled times and had their Pre-flight Breath Analyzer (BA) examination at approximately 08:26 IST (Instructor) and 11:35 IST (student) respectively. The results of BA examination for each crew were registered satisfactory.

In accordance with DGCA CAR Section 5 Series F Part III, onboard crew shall undergo medical examination if found involved in an accident or a serious incident. Both onboard crews were subjected to post accident medical examinations and were not found under the influence of alcohol.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The accident was survivable.

1.16 Tests and Research

The Garmin system installed on the aircraft was capable of recording a number of parameters, including engine data. Therefore, it was the best tool available on the aircraft to assess the serviceability of the engines based on the analysis of recorded parameters. But, in absence of SD cards on both onboard devices, the system failed to store files, and no information pertaining to flight could be retrieved from neither the cards nor the NVM of the units. Hence, to establish regarding the serviceability of engines, it was decided to perform engine testing.

The investigation team carried out an in-situ examination of the engine at the operator facility in Bhiwani to establish the probable cause of the power loss in both engines during the training flight. This exercise was performed from 21 June 2023 to 22 June 2023, and the results of those tests are appended to this report as Annexure 'B'.

1.17 Organizational and Management Information

1.17.1 M/s FSTC Flying School Pvt. Ltd

M/s FSTC Flying School Pvt. Ltd. is a DGCA approved Flying Training Organization (FTO) based at Chaudhary Bansi Lal Airport, Bhiwani in Haryana state. The Organization is headed by a Board of Directors. The Accountable Manager is assisted by the Engineering, Flight Operations and Administrative Sections of the organization. On the day of the accident, the organization's aircraft fleet comprised of two single engine aircraft (P2008 JC) and one muti-engine aircraft P2006T (aircraft VT-VDB). The organizational structure of the Flying training institute is presented below:

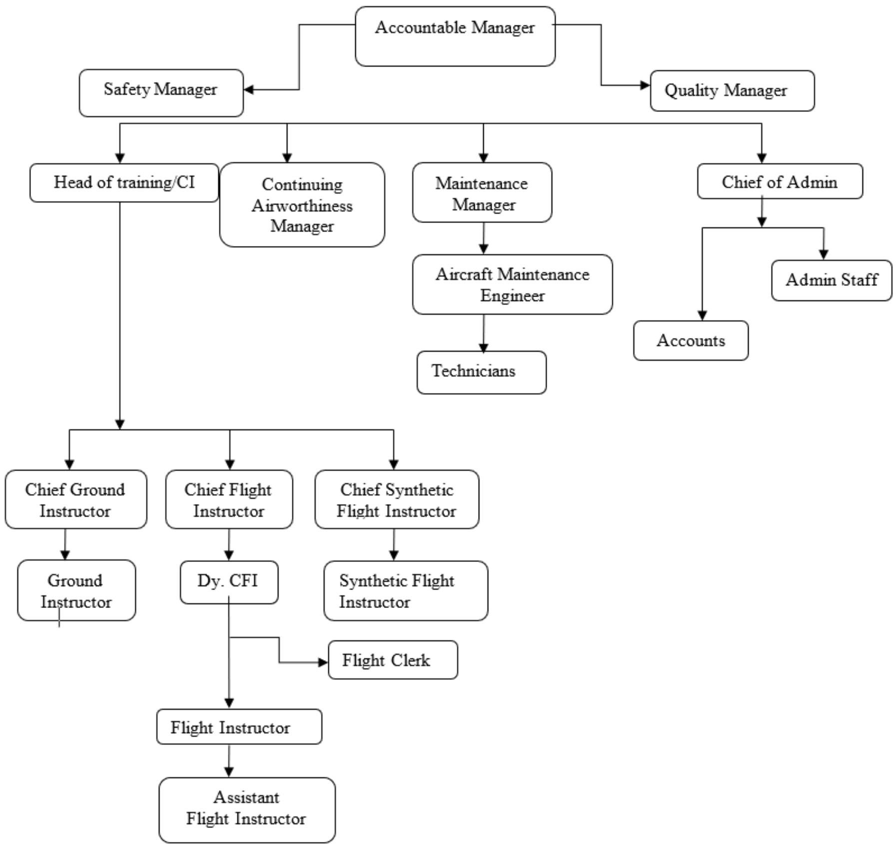


Fig :11 Organization Structure

1.17.1.1 Training & Procedures Manual (TPM) of the Organisation

The Company's DGCA approved Training and Procedure Manual Issue 01 Rev 01 was issued on 2 May 2022.

1.17.1.1.1 Chapter 5 of TPM

Para 5.14 contains guidelines on 'Carriage of proper fuel on board'. As per this section of TPM, during flight planning, it must be ensured that sufficient and proper fuel is carried onboard and following procedures are required to be adhered to by student pilots:

A flight shall not be commenced unless, taking into account both the 'meteorological conditions and any delays that are expected in flight, the 'aircraft carries sufficient fuel to ensure that it can safely complete the flight. The aim of flight planning is to know how much fuel is required to be carried on board for proposed flight. In addition, a reserve shall be carried to provide for contingencies and to enable the aircraft to reach the alternate aerodrome when such is included in the flight plan. The type of fuel used must meet the approved type of fuel specified by the manufacturers in their documents.

1.17.1.1.2 Circuit pattern and Checklist

Circuits are the exercise where a trainee also learns how to land an aircraft. According to the Instructor, the level out altitude during the circuit exercise was 700 feet AGL only. However, in the operator's FOB it was mentioned 1500 feet for circuit altitude.

The procedure to be followed during the circuit landing exercise is attached to this report as Annexure 'C'.

One of the documents to be carried on board and mandated by the DGCA is the checklist. Checklists are designed based on the procedures and guidelines outlined in the AFM and, therefore, they are aircraft type specific. The checklist must include both Normal and Emergency procedures. Post accident, the investigation team found the checklist in aircraft wreckage. The copy of the checklist is attached as Annexure 'D' at the end of this report.

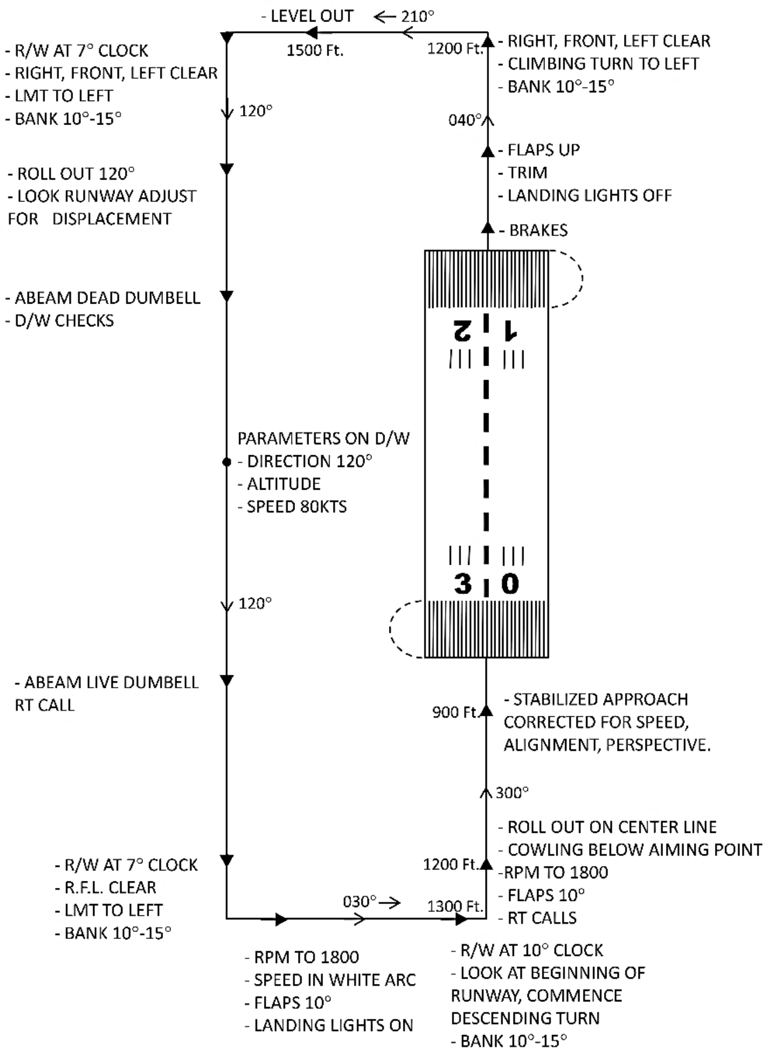


Fig 12: Left Hand Circuit Pattern Runway 30

1.18 Additional information

1.18.1 AFM: Normal Procedures and Emergency Checklists

Aircraft Flight Manual (Doc. No. 2006/044 4th Edition – Rev.17 dated July 02, 2021) has stipulated procedures and guidelines to be followed by crew at different phases of flight and during emergency situations, if arises during the flight. In addition to the procedures outlined in the AFM, it is also stated that ‘airplane has to be operated in compliance with limitations contained therein’.

1.18.1.1 Normal Procedures

Para 3.9 of Section 4 ‘Normal procedures’ outlined the procedures required to be followed by the crew during takeoff and climb. The relevant portion of Para 3.9 is provided below:

3.9. TAKEOFF AND CLIMB

1	Landing light	*ON*
2	LH and RH Electrical Fuel pump	*BOTH ON*
3	Carburettors heat	*CHECK OFF*
4	LH and RH Propeller Lever	*FULL FORWARD*
5	LH and RH Throttle Lever	*FULL POWER*
6	Engines instruments	*Parameters within green arcs*
7	Rotation speed	MTOW 1180kg: *Vr = 64 KIAS*; MTOW 1230 kg: *Vr = 65 KIAS*
8	Apply brakes to stop wheel spinning	
9	Landing gear control knob	*UP: check green lights and TRANS light turned OFF within about 20"*
10	Landing and taxi light	*OFF when required*
11	LH and RH Propeller Lever	*Set max cont power at* safe altitude

CAUTION *Max take off power must be limited to 5 minutes. Reduce Throttles MAP power before retracting Propeller to 2200 RPM or below.*

12	LH and RH Electrical Fuel pump	*BOTH OFF*

NOTE *It is recommended to retract landing gear when a positive climb rate is ensured at the applicable best speed (V_Y or V_X as necessary).*
It has been demonstrated that best climb rate is always obtained with flaps in UP position: refer to Section 5, "Take off rate of climb" and "Enroute rate of climb" tables.

1.18.1.2 Emergency Procedures

As per the AFM Section 3, Para 6.1, the minimum aircraft control speed defined for one engine inoperative condition (OEI) is 62 KIAS. In addition to this, following procedures to be followed by crew whenever aircraft encounter a single engine failure is shown below:

6. ONE ENGINE INOPERATIVE PROCEDURES

CAUTION

The ineffectiveness of one engine results in asymmetric traction which tends to yaw and bank the aircraft towards the inoperative engine. In this condition it is essential to maintain the direction of flight compensating the lower traction and counteracting the yawing effects by mean of rudder pedals. To improve directional control, it is advisable to bank the aircraft of about 5° to the side of the operating engine.

In addition, reduced available overall power and extended control surfaces will lead to a performances drop: a quick pitch attitude reduction will allow to keep a minimum safety airspeed.

The higher is the airspeed the better will be lateral and directional control efficiency: never allow airspeed to drop below V_{MCA}.

According to the Section 3 of the AFM, the procedures to be followed when one engine fails during climb is enumerated below:

6.4 ENGINE FAILURE DURING CLIMB

1.	**Autopilot**	**OFF**
2.	**Heading**	*Keep control using rudder and ailerons*
3.	**Attitude**	*Reduce as appropriate to keep airspeed over 62 KIAS*
4.	Operating engine Throttle Lever	*FULL THROTTLE*
5.	Operating engine Propeller Lever	*FULL FORWARD*
6.	Operative engine Electrical fuel pump	*Check ON*
7.	Inoperative engine Propeller Lever	*FEATHER*
8.	Inoperative engine	Confirm and *SECURE*

If engine restart is possible:

9. Apply INFLIGHT ENGINE RESTART procedure *see Para 6.2*

If engine restart is unsuccessful or it is not recommended:

9. **Land as soon as possible**
10. One engine inoperative landing procedure. *see Para. 6.6*

The guidelines and procedure stipulated in AFM regarding one engine inoperative landing and securing the engine are reproduced below:

6.6. One engine inoperative landing

WARNING

Thoroughly evaluate feasibility and plan in advance Single Engine Go-Around capabilities and expected climb gradient should a Missed Approach / balked landing be necessary. Refer to Section 5, Para 13 and 14 (One-engine Rate of Climb at V_{YSE} and V_{XSE})

WARNING

Autopilot must be kept OFF

1.	Seat belts	*Tightly fastened*
2.	Landing lights	*As required*
3.	Operating engine Fuel Selector	*Check correct feeding/crossfeed if needed*
4.	Inoperative engine Propeller Lever	*CHECK FEATHERED*
5.	Inoperative engine	*CHECK SECURED*
6.	Operative engine Electrical fuel pump	*ON*

When on final leg:

7.	Flap	*T/O*
8.	Landing gear	*Select DOWN and check three green lights on*
9.	Approach Airspeed	*V_{YSE}*
10.	Touchdown speed	*70 KIAS*

3. ENGINE SECURING

Following procedure is applicable to shut-down one engine in flight:

1.	**Throttle Lever**	***IDLE***
2.	**Ignition**	***BOTH OFF***
3.	**Propeller Lever**	***FEATHER***
4.	**Fuel Selector**	***OFF***
5.	**Electrical fuel pump**	***OFF***

The Landing procedure and pre touchdown actions to be followed by the crew in case of dual engine failure in flight, as defined in the AFM, are reproduced below:

10. Landing emergencies

10.1 Landing without engine power

CAUTION

In case of double engine failure both propellers should be feathered to achieve maximum efficiency. Best glide speed is attained with flap UP and equals V_Y for current aircraft mass and air density altitude. Refer to Section 5, Para. "Enroute Rate of Climb".

Normal landing gear extension requires MASTER switch ON, an efficient battery and takes around 20 seconds.

LG selection should be appropriately anticipated when sure on final.

Flap can be set to T/O or LAND when landing is assured on final to reduce landing ground roll on short field.

Touchdown speed can be as low as 50 kt with flap down.

1. Airspeed

MTOW 1180kg	MTOW 1230 kg
V_Y = 83 KIAS	V_Y = 84 KIAS

2. Flaps — *UP*
3. Emergency landing field — *Select*

WARNING

Emergency landing strip should be chosen considering surface condition, length and obstacles. Wind can be guessed by smoke plumes direction and tree tops or grass bending. Select touchdown direction according to the furrows of a plowed field, not across.

4. Safety belts — *FASTEN and tighten*
5. Flaps — *Set when landing is assured*
6. Landing gear control lever — *DOWN when landing is assured*

CAUTION

To reduce landing gear extension time, evaluate use of emergency control system which requires about 20 sec.

Before touch down

7. Fuel Selector — *BOTH OFF*
8. Electrical fuel pump — *BOTH OFF*
9. Ignitions — *ALL OFF*

After aircraft stops:

10. MASTER SWITCH — *OFF*

When stopped

11. Aircraft Evacuation — *carry out if necessary*

WARNING

Consider use of ditching emergency exit to escape in case pilot or passenger doors are blocked, watch for engine hot parts, fuel, hydraulic fluid or oil spills. Leave aircraft in upwind direction.

1.18.2 Asymmetrical Yaw

When one of the engines on a multi-engine aircraft becomes inoperative, a thrust imbalance exists between the operative and inoperative sides of the aircraft. This thrust imbalance causes several negative effects in addition to the loss of one engine's thrust. For reasons listed below, the left engine of a conventional twin-engine propeller-driven aircraft is usually considered critical.

When one engine becomes inoperative, a torque develops which depends on the lateral distance from the center of gravity (C.G.) to the thrust vector of the operating engine, multiplied by the thrust of the operating engine. The torque effect attempts to yaw the aircraft's nose towards the inoperative engine, a yaw tendency which must be counteracted by the pilot's use of the flight controls.

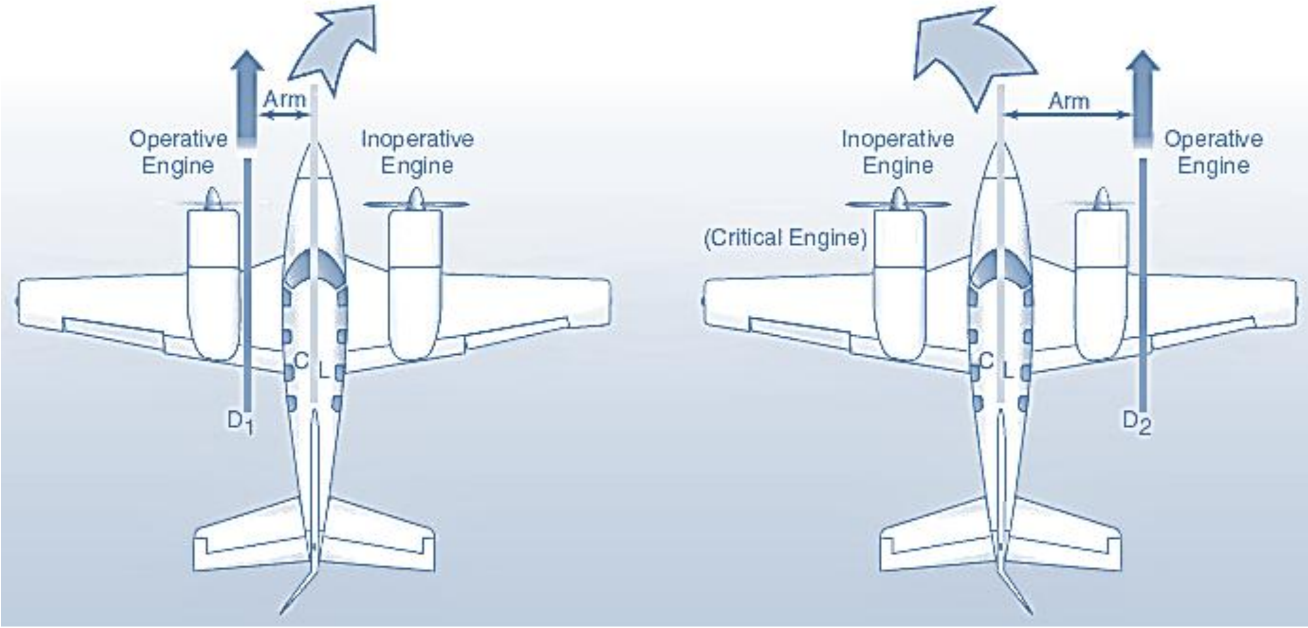


Fig 13: Effect of Left and Right Engine failure

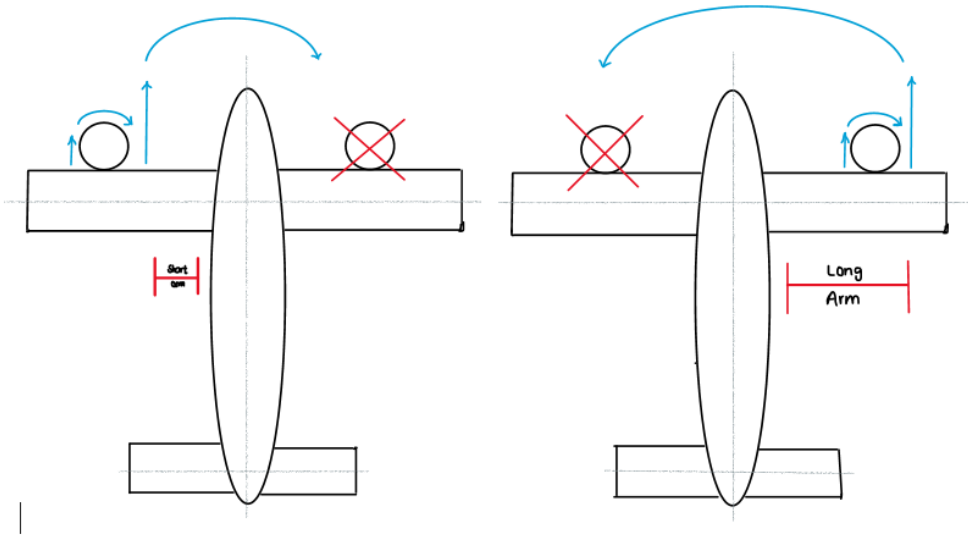
The operating right-hand engine will produce a more severe yaw towards the dead engine, thus making the failure of the left-hand engine critical.

Due to the asymmetric blade effect (P-factor), the right-hand engine typically develops its resultant thrust vector at a greater lateral distance from the aircraft's C.G. than the left-hand engine. The failure of the left-hand engine will result in a larger yaw effect via the operating right-hand engine, rather than vice-versa, and it is termed the Critical Engine (both propellers turning clockwise as viewed from the rear). Since the operating right-hand engine produces a stronger yaw moment, the pilot will need to use larger control deflections in order to maintain aircraft control.

Accelerated Slipstream

On aircraft with propellers mounted on the wing, the propwash from the engine will accelerate the airstream over the portion of the wing directly behind the propeller. This results in greater lift behind the propeller than at other spots on the wing. From the P-factor effect, the right wing's centre of lift will be further from the C.G. than the left-hand wing. While failure of either engine will cause a rolling motion towards the inoperative side, the rolling motion will be more severe with the right engine operating. Thus, the failure of the left-hand engine is critical.

The critical engine is the engine that if failed will have the most adverse effect on the CONTROL and PERFORMANCE of the aircraft.



Right Engine out Left Engine out

Fig 14: Yaw moment due to engine failure

Since the operating right-hand engine produces a stronger yaw moment, the pilot will need to use larger control deflections in order to maintain aircraft control.

1.18.3 Vapor Lock

Vapor lock is a condition where fuel in the fuel lines vaporizes, preventing proper fuel flow to the engine. This vaporization creates vapor bubbles that block the fuel lines, leading to engine malfunctions or failure. This happens when fuel temperature rises and the fuel pressure drops, especially on hot days or at high altitudes, causing the fuel to vaporize rather than remain in liquid form.

Vapour bubbles may crop up at any part of the fuel system. The occurrence of vapour does not necessarily imply that there is no fuel flowing to the carburettor. It rather lessens the fuel pressure to the extent that the engine ceases to operate as required. This phenomenon transpires when gasoline, usually in liquid form, changes to vapour following an increased temperature, reduced pressure, elevated Reid Vapor Pressure (RVP) of the gasoline, or a blend of any of these aspects. When ambient temperature increases during summer, incidences of vapour lock usually increase.

Fuel residence time in the hot sections of the system, mechanical vibration, and other factors also play a significant role in vapor lock behaviour. The altitude at which the engine is operating has two opposing influences: ambient temperatures are lower at higher altitudes, which improves fuel system cooling; but ambient pressures are also lower, making vaporization easier.

The formation of vapor lock can be prevented by incorporation of booster pumps in the fuel system. These booster pumps, which are used widely in most modern aircraft, keep the fuel in the lines to the engine-driven pump under pressure. The pressure on the fuel reduces vapor formation and aids in moving a vapor pocket along.

1.18.4 Fuel

As recommended by the OEM, the aircraft operator gave priority to Mogas over Avgas to run its Tecnam fleet. Mogas (short for motor gasoline) is automotive fuel that is sometimes used in aircraft. The General Characteristics of Mogas relevant to this investigation are described below:

1. Volatility:
    - Mogas has higher volatility than Avgas, meaning:
        - It evaporates more easily.
        - It poses a higher risk of vapor lock, especially at altitude or high temperatures.

2. Density and Energy Content:
    - Mogas has slightly lower energy content compared to Avgas.
    - The reduced heat content from the ethanol mixed gasoline results in slightly reduced aircraft performance or range.

3.Storage Stability:
    - Mogas has shorter shelf life than Avgas.
    - Degrades faster when stored, especially in high humidity or high temperature conditions.

Mogas normally has a much higher vapour pressure, which varies seasonally. With a high Reid Vapour Pressure (RVP) fuel the risk of vapour lock during take-off and climb increases, particularly if the aircraft operates in high ambient temperatures. The higher volatilities and vapour pressures of motor gasoline (MOGAS) may overload the vapour handling capabilities of some airframe and engine fuel systems leading to vapour lock and carburettor icing.

The Service instruction issued by ROTAX on 28 May 2021 stated that for Rotax 912S engine type, the fuel recommended was of Indian Standard IS 2796:2008. The relevant section of the Service Instruction is attached as Annexure ‘E’ to this report.

1.19 Useful or Effective Investigation Techniques

Nil

2.0 ANALYSIS

2.1 Serviceability of Aircraft

The aircraft records reflected that ADs, SBs and all mandatory modifications were found complied at the time of accident. Further, as per snag register, there was no pending snag reported on the aircraft prior to the accident flight.

Aircraft Engine

Inspection and testing carried out on both engines and their associated systems revealed that engines did not encounter any technical malfunction during the flight. Based on examination and analysis of relevant components and systems of both engines, it can be inferred that engines were serviceable at the time of accident and under normal conditions could generate power.

2.2 Weather Aspect

A portable device used for measuring various weather parameters recorded a temperature of around 46 ºC when utilized immediately after the accident. Further, as per the METAR information pertaining to Bhiwani airfield, the temperature was 44 ºC at 0900 UTC.

The temperature variation between the runway and at other locations of an airport during summer days can be significant, depending on daytime and local conditions. It is typically observed that runways and taxiways, made of dark asphalt or concrete, absorb and then re-radiates this heat, leading to significantly higher temperatures around these areas in comparison to other areas of the airport.

At higher temperatures, engines cannot deliver their maximum power and under such circumstances, mostly during takeoff and climb phase, few pilots occasionally assume partial loss of power as an engine failure because aircraft fails to achieve the desired climb rate due to reduced engine power output.

Further, when Mogas is used in the aircraft and the temperature around the runway is high, there is an increased risk of vapor lock formation in the fuel system. Since the aircraft was operating on Mogas near its upper temperature limit of +50 ºC, it appears that weather had likely played a significant role in this accident.

2.3 Crew Aspect

2.3.1 **Student Pilot**

The student pilot had primarily operated Cessna 152 and Cessna 172 aircraft while undergoing training at SVKM NMIMS Academy of Aviation, Shirpur. After completing 180 hours of training flight out of the required 200 hours (the minimum requirement for issuance of a CPL), the student pilot joined FSTC to complete the remaining 20 hours of training. These 20 hours included 15 hours of mandatory flight on a multi-engine aircraft.

The Student Pilot joined the second FTO (FSTC) on 3rd May 2022 and had an experience of around 1 hour 15 minutes on multiengine aircraft Tecnam P2006T before the accident occurred on 12 May 2022.

Since Cessna and Tecnam have different cockpit layouts and therefore, they are procedurally different in operations. The fuel control system of Tecnam P2006T aircraft is operated through overhead panels, whereas Cessna have a different provision to control the aircraft fuel system.

Furthermore, Tecnam P2006T engines are equipped with electric fuel pumps, and these are required to be mandatorily turned ON during critical phases of flight i.e takeoff and landing to ensure positive fuel supply to the aircraft engines. However, most of the Cessna variants lacks electric fuel pumps and therefore, provision of electric fuel pump switch is not there. Notwithstanding, few Cessna variants such as 172S, 172R are equipped with electric fuel pumps but these pumps are not mandated to be turned ON during takeoff and landing phase of the flight.

During the training flight, the student pilot flew the aircraft under the instructor's supervision, while the instructor simultaneously managed RT communications. After take-off from runway 30, the aircraft joined the circuit altitude 700 feet. Thereafter, Student Pilot followed the checklist and consequently electric fuel pump was switched off by operating the switch located on overhead panel. The aircraft completed the circuit pattern and landed uneventfully. As the sortie was scheduled for touch and go exercise, the student pilot did not stop the aircraft on the runway. Upon landing on the runway, aircraft decelerated for some distance following touchdown, but never completely stopped on the runway. After a continuous ground roll, aircraft gained sufficient speed and got airborne again. However, when it appeared to crew that left engine has failed, instructor took over the controls. Thereafter, aircraft remained under the command of Instructor until the accident occurred at Bhiwani airfield.

After the accident, when the aircraft came to halt, Instructor advised the Student Pilot to open the main door located alongside PIC seat. Although the left propeller was not rotating, the student pilot could not be able to open the main door of the aircraft.

According to the procedures elaborated in Tecnam P2006T aircraft AFM, the main door can be opened only if the oil pressure reaches below a threshold value or electrical supply to the door mechanism collapses. And this condition can only be met when the aircraft’s engine shuts down. This safety design is introduced to prevent inadvertent latch opening while propellers are running. But, to handle any emergency situation, provision is also provided to operate the door manually to bypass this safety design. As per the procedures, push and hold the red tab down and the door can be opened by operating the handle.

After the accident, once aircraft wreckage was shifted to hangar, it was observed that the main door opened normally, and it indicated that door operation system had no anomaly when it was operated by Student Pilot. As per AFM, the electric lock disengages after a complete loss of electric power, but it also states that after engine shut down, due to lag in oil pressure drop, it delays the normal opening of main door. The Student Pilot could not open the door from inside most probably either door latch operation was tried immediately after the engine shut down or else procedure laid down in the AFM had not been followed procedurally. Either situation suggests that Student Pilot was not fully aware of the system operation.

2.3.2 Flight Instructor

The scrutiny of records revealed that CPL was issued to the Instructor in the year 2008, however, he started his career as Flight Instructor in 2018. While working as an instructor in his previous organization, he imparted training to student pilots on Cessna aircraft’s. After switching over to FSTC on 1st Jan 2022, Instructor completed the ground classes and subsequently underwent 5 hours of instructional training flying with DGCA approved examiner. Thereafter, the Instructor was cleared to operate Tecnam P2006T aircraft in Feb 2022 and entrusted with the duties of Flight Instructor. The total flying experience gained by the Instructor while employed in FTOs was around 1588:52 hrs. As the instructor had recently joined the organization, the total hours accumulated on aircraft type P2006T was approximately 28:20 hrs. only, which included training, checks and endorsement hours too. It can be inferred from the above information that Instructor had limited experience on Tecnam P2006T aircraft compared to his vast experience on Cessna variants.

Once the left engine exhibited characteristics of power loss, Instructor took over the controls and flew the aircraft until accident occurred at Bhiwani airfield. It has been observed that Instructor followed the correct procedures to manage the asymmetric power and heading of the aircraft. Consequently, the rudder was applied and the aircraft was banked towards the live engine side to maintain aircraft directional control and counter asymmetric power.

However, examination of the aircraft wreckage revealed that left propeller was not feathered. This implies that the emergency checklist designed for one engine failure during climb & landing was not followed, and propeller configuration not changed to feather position even though crew had already established that left engine had failed.

Additionally, the landing gears were also not retracted during climb phase to reduce the drag, despite the crew were aware of engine failure. These factors collectively contributed in sudden decrease in aircraft forward speed.

Since the aircraft forward speed dropped, ambient temperature reached closer to operational limit and the fuel used was MOGAS, these factors collectively led to slight reduction in engine power. Subsequently, roughness in right engine was felt by crew. Instructor likely considered this loss in right engine power as engine failure.

Thereafter, Instructor reduced the right rudder pressure and aircraft's attitude was changed to wings level. By that time, the aircraft's speed had dropped to 55 knots, and it had already started sinking.

However, Instructor failed to comply with AFM and did not correct aircraft's pitch to maintain the minimum safe airspeed despite the speed was reducing during the climb. Further, the AFM states: 'the higher is the airspeed the better will be lateral and directional control efficiency and never allow airspeed to drop below V_{MCA}'.

Since the aircraft was operating on a single engine with reduced power, it could not maintain a continuous positive climb rate due to unfavorable conditions. This situation probably made the crew to believe that both engines had failed. Thereafter, crew looked for a field to perform the forced landing. As the aircraft had not sufficient height and was inside the airfield's premises, the instructor took the decision to carry out the forced landing at Bhiwani airfield itself.

The left engine's propeller completely stopped at an altitude of around 20 feet AGL and thereafter aircraft suddenly swung to the left. And to counter this sudden yaw to the left, crew likely had applied the right rudder. Subsequently, both nose landing gear and right main landing gear touched simultaneously on ground and collapsed. Since both the gears collapsed, the only landing gear i.e. the left landing gear came in contact with the ground and acted as pivot resulting in 180 degrees turn in aircraft heading. From this it can be inferred that aircraft right engine was generating power at that time and due to this asymmetric power aircraft heading changed. But after the impact and damages suffered by two landing gear, aircraft fuselage came in contact with the ground and subsequently it could not move ahead afterwards.

According to the Instructor, after crashed landing, Student Pilot was asked to evacuate by opening the main door. When the student pilot was unable to open it, the Instructor assumed that door had stuck and could not be opened. Till that time, engines were not secured, and the electrical system was ON. It is highly likely that the residual system oil pressure precluded normal operation of the main door; however, the crew assumed the door was jammed due to impact damage without attempting the alternate opening method.

Post accident, the instructor reported experiencing fuel vapor and hearing a sound indicative of a fuel leak while still inside the cockpit. Site examinations revealed no traces of a fuel leak from either engine; however, oil spillage was observed after the wreckage was cleared from the site. Later in-situ testing of the engines at the operator's facility confirmed the aircraft's fuel distribution system was undamaged and continuous.

After securing the engines and turning off all electrical switches, the instructor instructed the student pilot to open the rear door located towards starboard side. Once the door was open, both crew members evacuated the aircraft.

2.4 Fuel Aspect

The Aircraft manufacturer has specified two fuel types for Tecnam P2006T aircraft: MOGAS (ASTM D4814) and AVGAS 100 LL (ASTM D910). However, selection of the fuel variant is at the discretion of the aircraft operator, subject to fuel availability and local State regulations.

According to the AFM, prolonged use of Aviation Fuel AVGAS 100 LL results in greater wear of valves seats and greater combustion deposits inside the cylinders due to higher lead content. And therefore, it is suggested by OEM to avoid this type of fuel unless strictly necessary.

The MOGAS fuel, with the specification ASTM D4814, approved by the OEM allows blending of ethanol upto 10% subject to condition that fuel is meeting the specified fuel properties, including volatility.

Because MOGAS costs comparatively less than AVGAS and could be easily purchased from fuel vendors, the aircraft operator opted for MOGAS for its Tecnam fleet. Further, in the AFM, OEM had also recommended to give preference to MOGAS over AVGAS. Therefore, the MOGAS (Power 99) produced by the fuel company, at the time of accident having a 10% ethanol, was used by FTO for its Tecnam fleet. This 10 % ethanol blended fuel was available in the open market via the fuel depots.

Further, MOGAS (Power 99) supplied to the FTO had a RON value 99, which was higher than the specified minimum value (i.e. RON 95) approved by Engine manufacturer and permitted in India. Whenever ethanol is blended with petrol, it generally increases overall RON score of the fuel. And, as the RON value increases, it leads to increase in fuel volatility. Therefore, the engine manufacturer has clearly stated that fuel selected for aircraft operation must be based on specific climate zones and additionally should meet the local standards. The fuel composition of MOGAS (Power 99) met both the engine manufacturer’s requirements and local standards specified by OEM (10% ethanol and minimum RON 95).

Although the fuel was meeting the required specifications, at the time of accident, the ambient temperature (46ºC) had almost reached near to upper limit specified by the OEM i.e 50 ºC, therefore, it is very likely that fuel temperature inside the fuel supply lines reached to the critical temperature favorable for vapor formation.

Further, the aircraft circuit altitude was very low and therefore, no significant variation in temperature was encountered by the aircraft while flying at 700 feet AGL.

Because the aircraft speed and engine rpm decreased while the aircraft was on final approach, this configuration demanded less fuel to run the engine on idle or less power settings. Thereafter, fuel flow rate also dropped. Further, confined space inside the engine cowling, where significant heat is dissipated by engine, along with aforementioned factors created an ideal condition for MOGAS to reach its evaporation point.

Based on the above facts, it can be concluded that the aforementioned factors contributed to the formation of vapor lock in the fuel system, which disrupted the continuous fuel supply to the left engine. This interruption in the fuel supply subsequently led to left engine failure. Further, as the right engine also encountered similar conditions, these factors contributed in drop in right engine power.

Based on the above, it can be inferred that operating the aircraft under these environmental conditions while utilizing MOGAS contributed to the accident.

2.5 Organizational Aspect

According to the Circuit Pattern diagram published in the DGCA approved TPM, the operator had defined the circuit altitude of 1500 feet. However, the involved crew had confirmed that during the training flights, aircraft usually fly at 700 feet AGL as the circuit altitude for local flying was reduced. This implies that the organization without amending its TPM and approval from DGCA had revised the circuit altitude which is a non-adherence to procedures stipulated in DGCA approved document. However, after the accident, the operator confirmed that the local flying circuit altitude had been again raised to previous altitude.

During the investigation, the team scrutinized the Emergency Checklist, which is one of the mandatory onboard documents that every FTO must maintain on every aircraft. It was observed that the checklist size was too small in size, and all the emergency procedures were not clearly defined. The emergency checklist must clearly specify the crew actions in the event of both single and dual engine failures.

2.6 Non-adherence to AFM

According to the guidelines and procedures outlined in the AFM, when an engine fails during the climb phase, crew must follow the checklist and inoperative engine propeller lever should be turned to feathered position. Once feathered, the inoperative engine must then be secured. However, wreckage examination revealed that the left engine was not feathered, despite the crew having already established that left engine was the one that failed initially.

Further, the action defined in AFM to reduce the aircraft nose pitch attitude following single engine failure was not adhered by crew and therefore, aircraft could not maintain the minimum speed required for sustaining the flight. This indicates that crew did not adhere to the procedures stated in the said document. As the crew did not follow the checklist procedures, the aircraft started sinking when its speed reduced below the minimum recommended speed. Although the right engine was generating power, once the forward speed dropped below the minimum, aircraft handling became difficult. Consequently, crew were left with no option and forced landing was executed.

2.7 Circumstances leading to the Accident

Both METAR information and handheld device showed the ambient temperature at Bhiwani airfield approximately 44 ºC (at 0900 UTC) and 46 ºC (after 0918 UTC), when recorded at the time of training flying was in progress and post-accident respectively.

After takeoff from the runway, the student pilot, who was on the controls, followed the left-hand circuit pattern and carried out the actions as suggested in their company manual. After joining the crosswind leg, Student Pilot selected the electrical fuel pumps of both engines to 'OFF' position once the aircraft leveled out at 700 feet.

Since the aircraft was operating at a low altitude (700 ft AGL), it encountered no significant variation in temperature. Aircraft joined the final leg, following the completion of downwind leg and base leg. To maintain the aircraft speed between 70-75 Knots, engine throttle was pulled back and consequently engine power reduced.

As the aircraft speed reduced, the engine rpm also dropped. This consequently decreased air flow over the engines, directly affecting the overall cooling process. Simultaneously, the fuel pressure in the fuel lines also declined due to lower fuel flow rate in supply lines.

Once the aircraft touched down on the runway and started rolling, student pilot prepared for a touch and go exercise. Because the runway temperature was significantly high and simultaneously aircraft speed was decreasing, cooling effect decreased which caused rise in temperature in the cowling area.

And as the aircraft was also operating on MOGAS (Power 99) with 10 % ethanol, which is more volatile than AVGAS, these factors collectively attributed in the formation of fuel vapours in the fuel supply lines. Formation of fuel vapour further interrupted the fuel supply to the left engine. At that moment, the left engine encountered vapor lock, thus starving the engine of a constant supply of liquid fuel and, crew subsequently experienced roughness in engine. Thereafter, Instructor took over the controls and asymmetric power handling procedure was followed. But the instructor failed to comply critical steps of the checklist on 'single engine failure during climb' and therefore, neither feathered the propeller of dead engine (left engine) nor reduced the pitch attitude to avoid aircraft speed falling below minimum airspeed.

Since the aircraft was flying on ethanol mixed MOGAS and the overall energy content of the fuel reduced, it resulted into decreased engine efficiency at high temperature which affected the aircraft's climb rate also. Hence, after few seconds, the crew felt power loss and roughness in right engine also. Following factors such as high ambient temperature, non-feathering of propeller creating extra drag, crew's total focus on handling directional control and not to reduce the pitch attitude to maintain the aircraft speed, aircraft flying on MOGAS blended with ethanol producing less power and less experience of both crew on flying this particular aircraft type cumulatively created a situation where a drop in aircraft right engine performance was assumed as engine failure. And, by the time corrective action was taken, the aircraft's speed had already dropped below $\mathbf{V_{MCA}}$.

Subsequently, the crew opted for an emergency landing within the Bhiwani airfield. Forced landing was carried out by the crew but the aircraft landed on the nose and right main landing gear.

Although aircraft was fitted with electrical fuel pump to maintain a positive fuel feed and pressure output, to avoid formation of vapor lock, but it likely appears that the Student Pilot did not switch on the left engine electrical fuel pump while the aircraft was under his command and was coming for landing. All the fuel related knobs and switches are located on overhead panel and this could be the reason that even instructor also missed to recheck the final positions of all the switches. And this was corroborated with the facts that even both engines were secured after the accident, but one ignition switch on overhead panel was found in ON position while the others were at 'OFF' position. Hence, there could be high possibility that the left engine's electrical fuel pump was inadvertently left in OFF position while the aircraft was coming for landing and this could be one factor amongst other contributory factors for vapor lock formation and eventually failure of the left engine.

Post-accident, In-situ checks of the left and right engine had also established that both engines were serviceable at the time of accident as no technical anomaly detected during the examination, and the results of that exercise validated that the cause of left engine failure was primarily contributed by vapor lock.

3. CONCLUSION

3.1 Findings

3.1.1 Aircraft

1. The Certificate of Airworthiness, Certificate of Registration and Airworthiness Review Certificate of the aircraft were valid on the day of accident.
2.The aircraft and its engine were being maintained as per maintenance programme approved by the DGCA. All other laid down requirements pertaining to serviceability of aircraft were complied with, hence, serviceability of the aircraft did not contribute to the accident.
4. Load and Trim sheet was prepared before the training flight and center of gravity (C.G) of the aircraft was within the prescribed limits.
5. ELT of the aircraft activated after the accident and the organisation received a message from the concerned authority regarding the accident.

3.1.2 ATC

1. Bhiwani airfield was an uncontrolled airfield and ATC communication was held using handheld RT sets. Aircraft was in positive communication throughout the training flight.

3.1.3 Weather

1. The recorded ambient temperature post-accident at Bhiwani airfield was close to upper limit i.e 50° C set by OEM for operation of Tecnam P2006T aircraft.
2. Ambient temperature at runway strip was conducive for formation of vapor lock in the fuel system.

3.1.4 Fuel

1. Operator opted for MOGAS to operate the Tecnam fleet.
2. Fuel was checked prior to the sortie, and sufficient quantity of fuel was taken onboard to commence the flight.
3. MOGAS blended with 10 % ethanol was used to run the engines and was meeting the specifications stipulated by engine OEM.

3.1.5 Crew

1. The Flight Instructor was holding a valid license and was qualified for operating the training flight.

2. The Flight Instructor in his flying carrier of 14 years had majorly flown Cessna variants. After completing instructional training flying on Tecnam P2006T in year 2022, the instructor was permitted by DGCA to conduct instructional flying at the organisation.
3. The Student Pilot had completed 180 hrs of single engine flying on Cessna aircraft while undergoing training at a previous flying institute, before switching to FSTC to complete his multi-engine flying on Tecnam P2006T, to comply with the DGCA requirements for the issuance of CPL licence.
4. Both onboard crews overall experience on Tecnam P2006 T aircraft was significantly less to handle unforeseen emergency situations.
5. Crew did not follow the emergency checklist meticulously after left engine failure resulting in increasing of drag and reducing of aircraft speed below minimum.
6. Crew had neither transmitted left engine failure message nor May Day call to ATC, once it appeared to them that both engines had been failed.
7. Crew could not open the emergency door may be due to lack of experience on operational and design feature of the locking mechanism.

3.1.6 Operator

1. Aircraft was fitted with G3X Garmin units, but no SD card was installed on the device's slot designed to capture the aircraft parameters. However, two cards were found in the other slots of the units. The organisation did not make use of this medium to record the flight data and monitor the flying activities.
2. The data retrieved from the cards was Garmin Navigational data file and no aircraft or engine related parameters recorded.
3. The circuit altitude defined for local flying area was decreased from the approved height without amending the TPM and approval from DGCA.
4. The checklist formulated by the organisation was a single page checklist, very small in size and without clearly describing all the actions a crew must follow in different emergency situations.

3.2 Probable Cause

The accident occurred during climb as the aircraft left engine encountered vapor lock and right engine suffered slight loss in power while operating at ambient temperature close to operational limit, and during forced landing it impacted the ground, as a result of

- Non-adherence to the AFM procedures, wherein the aircraft was not handled according to the emergency situation.
- Pairing of two crews not having adequate experience on handling emergency situations on aircraft type

4.0 Safety Recommendations

It is recommended that

4.1 DGCA may advise all Flying Training Organizations not to park the Tecnam aircraft at apron area or on tarmac area for long periods during summer season before commencing next training flight.

4.2 DGCA may advise all Flying Training Organizations to establish a mechanism where a student pilot in initial phase of training must not be paired with the Flight Instructor having less experience on type and cannot effectively handle the emergency that may arise during the flight.

4.3 DGCA may issue directions to all Flying Training Organisations to give more emphasis on practicing the handling of emergency situations that may be encountered during critical phases of flight on Tecnam fleet.

4.4 DGCA may issue instruction to the Flying Training Organization to revise its checklist so that all the actions recommended by OEM to handle emergency situations must be explicitly covered in the checklist.

4.5 The OEM may review its instructions or guidelines regarding the criteria of fuel selection. Notwithstanding approval of country specific fuels, the OEM should recommend fuel grades based on local climatic conditions, as different regions within a country can sometimes exhibit significant temperature variations.

4.6 The OEM may consider lowering the upper limit of ambient temperature range (+50ºC), based on actual flying data gathered worldwide, to validate that current operational limit specified in AFM is safe and adequately maintains the safety margin when aircraft operates in hot weather condition.

SAFETY ACTIONS ALREADY IMPLIMENTED

DGCA has already issued instructions/advisory to FTOs to mitigate similar occurrences in future and two major proactive measures introduced are as follows:

1. A letter has been issued by the DGCA instructing all FTOs not to use MOGAS for refuelling their aircraft.
2. DGCA has issued an advisory to all FTOs not to conduct flying training operations above OAT 42 Degree Celsius.

Dated: 22nd May 2026
Place: New Delhi

ANNEXURE ‘A’

AIRCRAFT DAMAGE ASSESMENT

The damage observed on aircraft fuselage:

1) Drain pipes under fuselage (aircraft battery) broken.
2) Nose radome fully damaged.
3) LH & RH Pitot tube broken.
4) Multiple dents & cracks noticed in bottom skin both sides of Nose Landing Gear Wheel area.
5) Dent & Crack noticed on fuselage skin close to RH Pitot support tube assembly.
6) Outside Air Temperature probe fond broken.
7) Heavy damage on the bottom skin and structure before of pressure bulkhead. Dent and Crack noticed on bottom fuselage.
8) DME, TRANSPONDER, ADF, MKR & COM 1 antenna broken.
9) Rear door found broken.
10) Wind shield fully damaged.
11) Instrument panel damaged.
12) DR Compass found displace with broken wire.
13) Stabilator starboard side found damaged.
14) Cockpit rear side fully damaged.
15) Damage found on vertical stabilizer.

16) Fuselage belly fully damaged

Damages observed on Landing gears:

A. Nose Landing Gear

1) Nose wheel and landing gear fork has sheared from Oleo strut NLG wheel well area multiple dents, cracks and severe damage observed. NLG complete door assembly has damaged. NLG door link rods and hinges damage. NLG fork cracked and detached from Oleo Piston.
2) NLG doors and attachments are damaged.
3) Nose Landing Gear door LH half is dented and cracked.
4) Nose Wheel Steering Arm assembly cut.
5) Shimmy Damper detached from its mount.
6) NLG actuator eye end sheared. Actuator attaching fork end on NLG damaged.
7) Lower steering joint support assembly detached from its all three attachment.
8) Nose L/G door attachment link rods eye end found cut. And detached from Landing Gear.

B. LH MLG

9) LH Main landing gear broken
10) LH landing gear doors damaged.
11) Door is half detached from its hinge. Door hinge has cracked.
12) Door and MLG connecting rod end found broken.
13) Brackets on LH MLG supporting brake hydraulic lines found damaged.

C. RH MLG

14) RH Main landing gear broken
15) RH landing gear doors damaged.

Damages observed on Engines:

A. LH ENGINE

1) Cowling damaged left hand side.

B. RH ENGINE

1) Minor scratches found on cowling.
2) Mud scratches found on propeller.

Damages observed on Wings:

A. RH WING

1) RH wing damaged (leading edge damage from wing tip to root side 70 CM, mid of the wing damage 60 CM, distance from engine installation 75 CM.
2) RH aileron fully damaged.
3) Wing Root Fairing dented and cracked.
4) Multiple wrinkles observed on leading edge to trailing edge.
5) Small dent noticed on wing leading edge
6) Dent noticed on inbound flap hinge bracket on flap assembly.
7) Dents noticed on the top of flap assembly at trailing edge.
8) Fuel leak found below the integral fuel tank area.

B. LH WING

1) Wing skin riveted joint opened on top of wing root side.
2) Wing root fairing fully damaged.
3) Flap fully damaged.
4) Aileron fully damaged.
5) Fuel leak found below the integral fuel tank area.
6) Scratch noticed on wing top skin
7) Dents noticed on bottom side of flap. Flap top side trailing edge damaged.
8) Inboard hinge bracket on the flap found bent and dented and cracked.

ANNEXURE 'B'

Tecnam P2006T aircraft Checklist: **Normal Checklist**

TECNAM P2006T CHECKLIST

PREFLIGHT

LANDING GEAR HANDLE	DOWN
CERT/DOC	ON BOARD
HOBBS 1 & 2	RECORD
PARKING BRAKE	ON
ALL ELECTRICAL	OFF
MASTER SWITCH	ON
FUEL QTY & SELECTOR	CHECK, L-L, R-R
ELECTRIC FUEL PUMPS	CYCLE, CHECK
LANDING GEAR LIGHTS	TEST
ELT & CBs	ARMED/IN
FIRE DETECTION TEST (PRESS)	PFD DISPLAY
ALT STATIC SWITCH	CLOSED (AFT)
TRIM SWITCH	ON
TRIM CONTROL X 2	NEUTRAL
START BATTERY VOLTS	12–14 V
MASTER SWITCH	OFF
EXTERIOR	USE POH
FLIGHT CONTROLS	CHECK CORRECT

BEFORE START

PARKING BRAKE	ON
CHOCKS	REMOVED
PASSENGER BRIEFING	COMPLETE
SEATS & SEAT BELTS	ADJUSTED
DOORS	CLOSED

ENGINE START L/R (DAY)

MASTER SWITCH	ON
AVIONICS	ON
START UP	RT CALL
AVIONICS	OFF
STROBES	ON
DAY/NIGHT SWITCH	AS REQUIRED
CHOKE	ON (IF OIL TEMP<50°C)
THROTTLES	CLOSED
PROP LEVERS	FULL FWD
CARB LEVERS	FULL FWD
FUEL PUMP	ON AND CHECK FP
AREA	CLEAR
IGNITION SWITCHES	ON
START BUTTON	PRESS
FIELD SWITCH	ON
OIL PRESSURE	WITHIN 10 SEC MAX 7 BAR
THROTTLE	1000 RPM
AVIONICS SWITCH	ON
CROSS BUS SWITCH	ON
AMMETER	POSITIVE
VOLTMETER	12-14 V
CHOKES	OFF
THROTTLE	1000 RPM

REPEAT FOR OPPOSITE ENGINE

HOT START

CHOKES	CLOSED
START BUTTON	PRESS
THROTTLE	SLOWLY OPEN ONE INCH

FLOOD START

CHOKE	CLOSED
THROTTLE	OPEN
START BUTTON	PRESS
THROTTLE	QUICKLY IDLE

PRE-TAXI

FUEL SELECTORS	XFEED CHECK
FUEL PUMPS	OFF & CHECK
FUEL PRESSURE	MONITOR
EXT LIGHTS	NAV LIGHT ON
FLAPS	CHECK OPERATION
TRANSPONDER	SET CODE
COMM/NAV/FPL	CHECK/SET
ALTIMETERS	SET & XCHECK
FLT/ENG INST	CHECK (OIL TEMP>50°C)

GROUND RUNUP

PARKING BRAKES	SET/ON
FUEL SELECTORS	L-L & R-R
PROP LEVERS	FULL FWD
THROTTLES	1700 RPM
IGNITION SWITCH L/R	130 DROP/<50Δ
PROP LEVER	CYCLE (UPTO 4 TIMES)

- RPM - 100 RPM MAX DROP
- MAP – RISE
- OIL PRESSURE – DROP
- FUEL PRESSURE – DROP

CARB HEAT FULL BACK & CHECK RPM DROP	
THROTTLES	IDLE SLAM CHECK
THROTTLES	1000 RPM
FIRE DETECTION TEST	AUDIO & DISPLAY

TAXI

TAXI PERMISSION	RT CALL
BRAKES	CHECK SERVICEABILITY

BEFORE TAKEOFF

COMM/NAV/FPL	CHECK/SET
FUEL SELECTORS	L-L & R-R
FUEL PUMPS	ON & CHECK FP
IGNITION SWITCHES L/R	CHECK ALL ON
PROP LEVERS	FULL FWD
CARB HEAT	FULL FWD (OFF)
CHOKES	OFF
FLAPS	T/OFF (3 SECS)
CIRCUIT BREAKERS	CHECK ALL IN
TRIM & TRIM SWITCHES	TEST/SET 0°/ON
FLIGHT CONTROLS	FREE
PITOT HEAT	AS REQ
AHRS*	XCHECK
SEATBELTS	FASTENED
DOORS/WINDOWS	LOCKED
DEP BRIEFING	COMPLETE
TRANSPONDER	SET/ALT
EXT LIGHTS	LDG LIGHT ON/ALL ON
HEADING	CHECK ON RUNWAY
PARKING BRAKE ENSURE	OFF

AFTER TAKE OFF

BRAKES	APPLY, FEET DOWN
LDG GEAR (WITH POSITIVE ROC)	UP
FLAPS	UP AT 300 AGL, TRIM
POWER/PROP LEVERS	27"/2250 RPM
FUEL PUMPS	SINGLY OFF/CHECK FP
CRUISE CLIMB	95-105 KIAS
EXT LIGHTS	LDG LIGHT OFF

CRUISE

SLOW CRUISE	22"/1900 RPM
MEDIUM CRUISE	22"/2000 RPM

DESCEND

PROPS	2250 RPM
ATIS/ALTIMETER	RECORD/SET (QNH/QNE)
FUEL PUMPS	BOTH ON
SEATBELTS	FASTENED
APPROACH	BRIEF
EXT LIGHTS	ALL ON

LANDING

PROP LEVERS	FULL FWD
FUEL PUMPS	CHECK ON
LDG GEAR (SPEED<122KIAS)	DOWN
FLAPS (SPEED<122KIAS)	T/OFF
LDG GEAR DOWN	3 GREENS
FLAPS (SPEED<93KIAS)	FULL
APPROACH SPEED (WITH FULL FLAPS)	75 KIAS
FLAPS TO T/OFF	80 KIAS
FLAPLESS	80 – 85 KIAS

AFTER LANDING

TRANSPONDER	SET 1200
FLAPS	UP
FUEL PUMPS	BOTH OFF
EXT LIGHTS	LDG LIGHT OFF
PITOT HEAT & A/P MSTR	OFF
TRIM P & R	NEUTRAL

SHUT DOWN

PARKING BRAKE	ON
THROTTLES/ENGINES	IDLE, COOL 1"
FLAPS	CHECK UP
TRIM P & R	CHECK NEUTRAL
AVIONICS/CROSS BUS SWITCHES	ALL OFF
IGNITION SWITCH ONE AT A TIME	OFF
L/R FIELD SWITCHES	OFF
EXT LIGHTS	ALL OFF
MASTER SWITCH	OFF
EMER BATTERY LIGHT	CHECK OFF
EMER COCKPIT LIGHT	CHECK OFF
HOBBS 1 & 2	RECORD
DISCREPANCIES	RECORD
PARKING BRAKE	RELEASE/OFF
CHOCKS	IN
STALL SENSOR/PITOT COVER	ON

SPEEDS (TAKE OFF)

V_{MC} – 62 KIAS

VR – 65 KIAS

V_X – 72 KIAS

V_Y/V_{YSE} – 84 KIAS

*AHRS- ATTITUDE & HEADING REFERENCE SYSTEM

*Original size of the checklist

Emergency Checklist

EMERGENCY PROCEDURES

ENGINE FAILURE

MAINTAIN DIRECTIONAL CONTROL — V_{YSE} 84 KIAS/A/P OFF
ATTITUDE AS REQUIRED — MAINTAIN > V_{MC} 62 KIAS
PROPELLERS — FULL FWD
THROTTLES — FULL FWD
LANDING GEARS — UP
FLAPS — UP
IDENTIFY DEAD ENGINE — DEAD FOOT = DEAD ENGINE
VERIFY DEAD ENGINE — SLOWLY RETARD THROTTLE
TS* ALTITUDE PERMITTING — BOOST PUMPS ON XFEED?
FEATHER DEAD ENGINE — PROP LEVER TO FEATHER
ZERO SIDE SLIP — BANK 3-5° INTO GOOD ENG, BALL ½ OUT
TAKE CARE OF GOOD ENGINE — 27"/2250 RPM
TRIM — AS REQUIRED

SECURE DEAD ENGINE

THROTTLE LEVER — IDLE
IGNITION SWITCHES — BOTH OFF
PROP LEVER — FEATHER
FUEL SELECTOR — OFF
ELEC FUEL PUMP — OFF

OPERATING ENGINE MINIMIZE LOAD

ELEC FUEL PUMP — OFF
ELECTRICAL LOAD — MONITOR
FUEL BALANCE/XFEED — MONITOR

INFLIGHT RESTART

GOOD ENGINE POWER — AS REQUIRED
CARB HEAT — AS REQUIRED
FUEL PUMP — ON
FUEL QUANTITY — CHECK
FUEL SELECTOR — CHECK - XFEED IF REQ
FIELD SWITCH — OFF
IGNITION — BOTH ON
ENGINE THROTTLE — IDLE
PROP LEVER — FULL FWD
START BUTTON — PRESS
FIELD SWITCH — ON
POWER LEVERS (THROTTLES) — EQUALISE (SCISSOR)

V_R	65 K (70 – NF)	V_{S0} (1.5)	80K
V_{MC}	62 K	V_{S1} (1.3)	85K
V_X	72K	V_{NE}	171K
V_Y & V_{YSE}	84K (CLEAN)	ENROUTE CLIMB	95-105K
V_A, V_{LO}, V_{FE} (T/O)	122K	X-WIND	17K
V_{FE} (FULL)	93K	APPROACH	90K
V_{NO}	138K	FINAL	75K
V_{S0} / V_{S0} (1.3)	53K/69K		

ENGINE FIRE IN FLIGHT

CABIN HEAT AND DEFROST — OFF
AUTOPILOT — OFF
AFFECTED ENGINE FUEL SELECTOR — OFF
AFFECTED ENGINE IGNITION SWITCHES — OFF
AFFECTED ENGINE THROTTLE — CONFIRM OFF
AFFECTED ENGINE PROP LEVER — CONFIRM OFF
AFFECTED ENGINE ELECT FUEL PUMP — OFF
AFFECTED ENGINE FIELD SWITCH — OFF
CABIN VENTILLATION — OPEN
LAND — ASAP

EMERGENCY DESCEND

THROTTLES — FULL IDLE
FLAPS UP AND SLOW TO BELOW — V_{LE} 122 KIAS
LANDING GEAR — DOWN
MAX DESCEND SPEED V_{LE} 122 KIAS — CHECK

TOTAL ELECTRICAL FAILURE

EMERGENCY LIGHT — ON IF REQ
MASTER SWITCH — OFF
L/R FIELD SWITCHES — OFF
MASTER SWITCH — ON
L/R FIELD SWITCHES — ON
IF FAILURE PERSISTS – EMERGENCY BATTERY SWITCH — ON

MANUAL LANDING GEAR EXTENTION

AIRSPEED — BELOW V_{LE} 122 KIAS
LANDING GEAR HANDLE — DOWN
EMER LANDING GEAR EXT ACCESS DOOR — REMOVE
RIGHT EMER CONTROL LEVER — 90° CCW
WAIT FOR 30 SECONDS FOR PURGING
LEFT EMER CONTROL LEVER — 180° CCW

INFLIGHT SHUTDOWN (FOR TRAINING)

THROTTLES — IDLE
IGNITION SWITCHES (ONE AT A TIME) — OFF
PROP LEVER — FEATHER
FUEL PUMP — OFF
RECORD WHICH ENGINE WAS SECURED

- TS – TANK SELECTION

***THIS CHECKLIST IS FOR TRAINING PURPOSES ONLY!
***REFER TO THE POH FOR MORE COMPLETE INFORMATION!

*Original size of the checklist

Procedure followed during circuit landing exercise on Tecnam multi engine (P2006T) aircraft

AIM: the aim of the exercise is to have systematic departure and arrival procedure. The circuit landing exercise is divided into three parts namely:

(i) Circuit Pattern
(ii) Approach
(iii) Landing

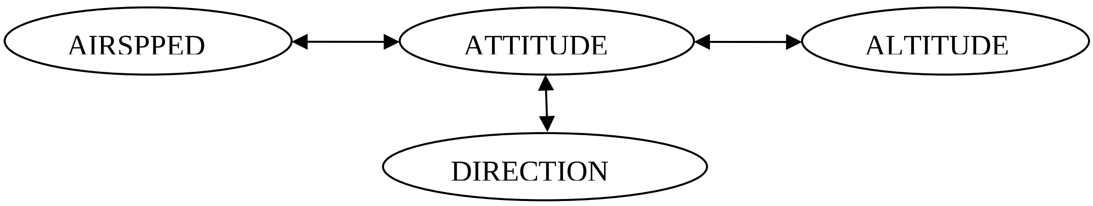
The elaborated explanation is as follow:

(i) CIRCUIT PATTERN

— After line up on the runway, do before takeoff checks and obtain departure clearance from ATC.
— After receiving departure clearance, release breaks, put heels on the floor, smoothly opening full throttle looking at the far end of the runway.
— Airspeed is alive, check oil pressure, oil temperature, fuel pressure is in green arc, reaching rotation speed, unstick the aircraft, get airborne and maintain shallow climbing attitude. Safely airborne, positive rate of climb, breaks applied, landing gear up.

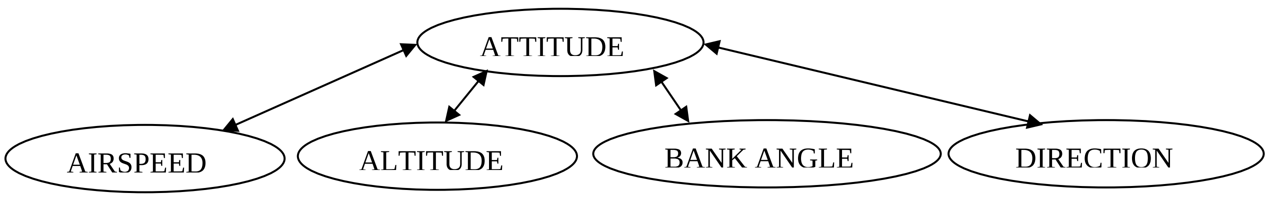
Note: - The centerline will be visible for few second, maintain centerline and notice the wind drift and give correction accordingly.

— Maintain V_Y / V_{YSE} and start with the scan pattern of:



— At 300 feet AGL, confirm clear of obstacles, retract flaps. Nose will tend to go down, maintain correct climbing attitude (speed 95-100 KIAS) and trim the aircraft, switch off landing lights, reduce throttle to 26'' of manifold pressure, reduce propeller lever to the beginning of yellow arc (RPM 2250) and continue with your scan pattern.

— At 700 feet AGL, check turn path clear, cross check with the ground features, cater for winds and commence a climbing turn. Scan pattern in turn is



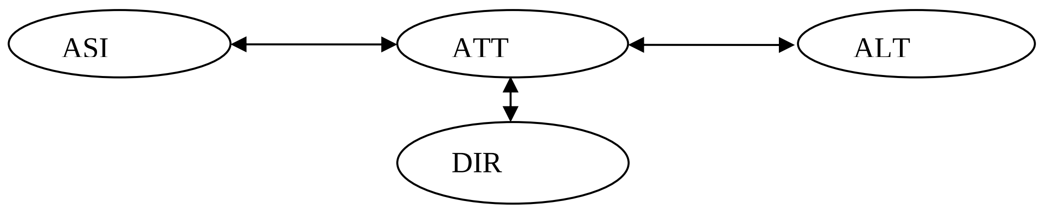
Bank angle to be maintained is 10° to 15°

Note: - (a) if altitude is reached before the crosswind leg heading, lower the attitude to maintain level attitude, reduce throttle 22'' of manifold pressure, reduce propeller lever to the 2000 RPM and continue turning. Anticipate 10 degree prior crosswind leg heading and roll out. Never trim in turns. Trim after rolling out of the turn if required.

(b) If direction of crosswind leg is reached before reaching circuit altitude, roll out 10 degrees prior, continue climbing. After reaching circuit altitude, lower the attitude, reduce throttle to 22’’ of manifold pressure, reduce propeller lever to 2000 RPM and trim the airplane as required.

(c) Reaching end of crosswind leg, cross check with the runway, cross check with the ground features, cater for the winds, check turn path clear and turn for downwind. Follow the scan pattern for turn. This is a level turn. Maintain bank angle between 10° to 15° but not beyond 20°

— Anticipate 10 degree prior and roll out on downwind. Pick up a reference at the far end of the downwind and continue with the scan pattern of



— Abeam dead dumbbell, do before landing checks as follows:

- Doors and windows lock
- seat belts on
- brakes checked
- check all engine parameters in green
- confirm speed below 122 KIAS
- landing gear down
- timer on stand by

Keep the scan pattern continuous and confirm parallel to the runway.

— Abeam live dumbbell, start timer, confirm 3 greens [landing gears down & locked], extend flaps to take off. Nose will tend to go up, maintain shallow descending attitude and trim the aircraft.

— Reaching end of downwind, check turn path clear, cross check with the ground features, cater for the winds, commence a shallow descending turn to base leg, following scan pattern for turn.

(ii) APPROACH

— Anticipate 10 degree prior, roll out on base leg.

— Do base leg checks of propeller lever fully forward, **fuel pumps on for left and right engine**, landing lights on, reduce throttle to 20’’ of manifold pressure,

— Scan far end of the runway to the beginning of the runway, runway end approach path is clear, continue with your scan pattern.

— Once runway reaches 10 O’ clock/ 2 O’ clock, turn for finals. Now the scan pattern changes to runway, attitude, airspeed.

— Roll out on finals with 500 feet AGL on top of finals.

— Now the reference has shifted from the natural horizon to the line which is parallel to the natural horizon, passing through the numbers. Keep the cowling position on the threshold.
— Scan far end of the runway to the beginning of the runway.
— Scan pattern now changes to ALIGNMENT, SPEED, PERSPECTIVE.

Note: - (a) ALIGNMENT is a continuous process and it is corrected using ailerons.
(b) SPEED is corrected using throttle. If speed is high, reduce throttle and maintain correct attitude with respect to the reference. If speed is low increase throttle and maintain correct attitude with respect to the reference. Trim the aircraft after throttle input if required.
(c) PERSPECTIVE is corrected using throttle. If perspective is high, reduce throttle and trim as required. If perspective is low, increase throttle and trim as required. Maintain attitude correctly with respect to the reference.
(d) Do not use trim below 100 feet AGL.

— Confirm speed below 93 KIAS, flaps to landing and trim the aircraft. Anticipate the speed will wash out, give throttle input to maintain approach speed of 70-75 KIAS.

(iii) LANDING

— Once getting closer to the runway, reduce throttle accordingly.
— Through your peripheral vision, you will notice the runway edge line start opening wide. This is where you go past the parallel.
— Now the reference has shifted from the line parallel to the natural horizon passing through the numbers to the lines parallel to the natural horizon passing through the far end of the runway.
— Keep the cowling position slightly below the reference at far end of the runway. Once the aircraft sinks, flare and hold the attitude.
— Once the aircraft touchdown bring throttle to idle, maintain direction with rudder, gently apply brakes and stop the aircraft.

Note: (a) never force the aircraft to land. It will land on its own after it floats.
(b) maintain correct flare height to avoid tail strike. Give one check only and hold the controls till touchdown.
(c) in case of approach un-stabilized, never commit to landing and initiate a go around.

— In case of:
- low balloon, low bounce hold the controls and wait for the aircraft to touchdown.
- high ballon, high bounce or PIO initiate go around.

Selection of suitable operating fluids for ROTAX® Engine Type 916 i (Series), 915 i (Series), 912 i (Series), 912 and 914 (Series)

ATA System: 12-10-00 Operating fluids

5) Fuel

NOTICE The aircraft manufacturer has to show compliance to the relevant requirements and standards on aircraft level for the suitability of any fuels in their product (by make and model). Using aircraft manufacturer approved fuels at critical temperature in all approved operating conditions (also including departures with a heat-soaked engine) is essential regarding being free from vapor lock as this issue is strongly dependent on the aircraft fuel system design. Aircraft operating limits can be different than the relevant ROTAX® aircraft engine operating limits.

For ROTAX® aircraft engines different fuel types are available. See Operators Manual (OM) of the relevant engine type and/or the table in chapter 5.3. This service instruction shows approved fuels for ROTAX® aircraft engines based on the various engine operating limits.

NOTE: If none of the fuels mentioned in chapter 5.3 is available, consult the corresponding European Standard EN228 as a reference. The fuel to be assessed, has to be equal or better.

NOTICE Any mixture of unapproved fuels and/or additives that cause lower than the specified octane rating can cause engine damage like e.g. detonation.

5.1) Automotive fuels

In addition to AVGAS, various automotive fuel types with different quality are available. Due to various environmental, economic and political reasons a number of fuel types with different amounts of ethanol blend are available. Therefore the maximum amount of ethanol blend is defined as follows:

5.1.1) E10 (Unleaded gasoline blended with 10% ethanol)

In addition to AVGAS and unleaded automotive fuel (MOGAS) the ROTAX® 912/914 Series of engines are now approved for use with E10. Fuels that contain more than 10% ethanol blend have not been tested by BRP-Rotax and are not permitted for use.

5.1.2) Suitability of fuel system components of airframe

BRP-Rotax urges owners to confirm with their airframe manufacturer that ethanol blended fuels of up to 10% (E10) are compatible with all fuel system components.

It is the responsibility of the aircraft manufacturer to test their fuel system components and supply any further information on techniques, procedures and limitations of using ethanol blended fuel.

BRP-Rotax recommends that aircraft manufacturer and owner/operators read the following:

- FAA Advisory Circular Letter AC 23.1521-2
- FAA Advisory Circular Letter AC 33.91-1
- FAA Special Airworthiness Information Bulletin CE-07-06
- EASA Safety Information Bulletin – SIB 2009-02

These contain details regarding the use of ethanol (alcohol) blended fuels and the type certificate requirements.

It is strongly recommended that non-certified aircraft also conform to the information given in the above documents.

5.2) AVGAS fuel additives

Additives under the names of Decalin® and Alcor®, which aid the scavenging of lead deposits have not been tested by BRP-Rotax. Field experience shows that these products significantly

5.3) Fuel according to local standards

The following fuels can be used.

NOTICE Use only the correct fuel for the specific climate zones.

NOTE: There is a risk of vapor lock formation if winter fuel is used for summer operation. So use summer blend fuels only in summer and winter blend fuels must only be used in winter conditions.

Engine Type 912 A/F/UL - 912 S/ULS - 914 F/UL

	Usage/Description	
	912 A/F/UL	**912 S/ULS - 914 F/UL**
	Min. RON 90	Min. RON 95
Indian standard (date: 2008)	IS 2796:2008	IS 2796:2008
	MG 91	
	MG 95	MG 95

NOTE: AVGAS is rated by MON values. AVGAS 100LL has a high lead content and forms deposits in the combustion chamber and piston rings as well as lead sediments in the oil system. However AVGAS is approved for use and it is beneficial in cases of problems with long storage periods, vapor lock or when other types of fuels are not available. Altitude and ambient temperature should also be considered when selecting AVGAS fuel to help prevent a vapor lock scenario.

6) General engine operation requirements and operating tips

1. Keep the engine oil temperature below 120 °C (250 °F) over most of the operating period.
2. Always insure that the oil type used is adequate for climatic conditions and peak engine operating temperatures. If operational oil temperatures exceed 120 °C (250 °F), use of a mineral or petroleum based oil is not recommended.
3. For turbocharged engines ensure an adequate running cool-down period to prevent deposits by coking of oil.
4. When operating with unleaded fuels or MOGAS and when engine oil temperatures often exceed 120 °C (250 °F) use of a high quality full synthetic oil is recommended.
5. To avoid formation of condensation water in the engine oil, the oil temperature must rise at least once every operational day to at least 100 °C (212 °F).
6. Avoid extended use of carburetor air pre-heating when safe and reasonable.
7. Automotive fuels have seasonal blends and MUST be used in the correct season. Failure to do so can cause hard starting or serious issues like vapor lock.
8. Depending on the type of fuel used, operating conditions, and the demands of the engine mission profile it may be necessary to increase the frequency of oil changes to avoid the excessive build up of lead and other residues in the engine oil. Always adjust the engine oil change intervals to avoid excessive build up of sludge in the engine oil.

NOTICE Do not use oil additives and observe the operating limits as per the relevant Operators Manual.

NOTE: Aircraft manufacturer should follow hot test and block testing recommendations such as FAA AC 23.1521-2 for verification of automotive fuels.

Excessive engine vibration, particularly at low idle speeds, can impair the carburetor fuel metering system leading to a too rich mixture condition. This rich mixture condition can further lead to rough engine operation and excessive carbon and lead deposits.

ANNEXURE ‘E’

ENGINE EXAMINATION REPORT

On 12 May 2022, one Tecnam P2006T aircraft VT-VDB belonging to M/s FSTC Flying School met with an accident while carrying out local training Flight at Bhiwani. The investigation team was instituted by DG, AAIB to investigate into the cause(s) and contributory factors leading to this accident. Undersigned was elected as SME to assist the IIC.

The investigation team planned a visit to Bhiwani Airfield from 21 June 2023 to 22 June 2023 so that based on the engine examination and in situ inspection, the factors attributed for loss of power for both the engines during the said flight can be established. Accordingly, the operator was informed well in advance so that they could arrange necessary man and material to assist in this exercise. Team reached Bhiwani Airfield at 1330 IST and following tasks were carried out:

1. Visual Inspection of both engines
2. External inspection of relevant components and connections
3. External inspection of relevant Systems (Ignition and Fuel System etc.)
4. Operational check of Mechanical Fuel Pump and Electrical Fuel Pump
5. Operational check of Electrical System
6. Cranking of both propellers

Before examining engines, the team had requested the operator to provide the relevant literature pertaining to the Rotax 912S engine. The operator provided two documents, namely Engine Maintenance Manual and POH. After going through the literature, the physical inspection of the aircraft was carried out and it was observed that the aircraft was substantially damaged, however, except damage to propeller blades no other significant damage was observed externally on both the engines. Propeller blades of both Starboard as well as port side were found bent at tip section.

1. After visual inspection, the cowling of the left engine was first removed. After referring to the maintenance manual and the POH, visual inspection of different components of fuel system, ignition system and electrical system were carried out. External condition of Ignition System, fuel system and electrical system was found satisfactory.
2. Carburetor intake fuel lines were also inspected, and they were found intact with no sign of external damage.
3. The Mechanical Fuel Pumps installed on both engines were inspected visually and no external damage was observed. The inlet and outlet fuel lines were also checked, and they were found intact.
4. Ignition System of both the engines was inspected and no damaged was observed either on H.T leads or Spark plugs. It was noticed that the ignition leads are securely attached to respective spark plugs without any cut or damage.
5. Aircraft battery was checked and found with no sign of external damage.
6. After this exercise, the Electrical Fuel pump on the left side was checked in situ to confirm its serviceability. Initially, the aircraft battery was utilized to check the Electrical Fuel pump but when it did not work out, the ground power source was connected. Once the ground power source was connected and pump was selected to ‘ON’, the pump started normally and this confirmed that the pump is serviceable.
7. Finally, the team had referred to all the maintenance Schedules including the last Schedule carried out on the aircraft before it met with the accident. Once it was confirmed that all the schedules were followed and the aircraft was maintained as per the OEM guidelines, it was decided by the

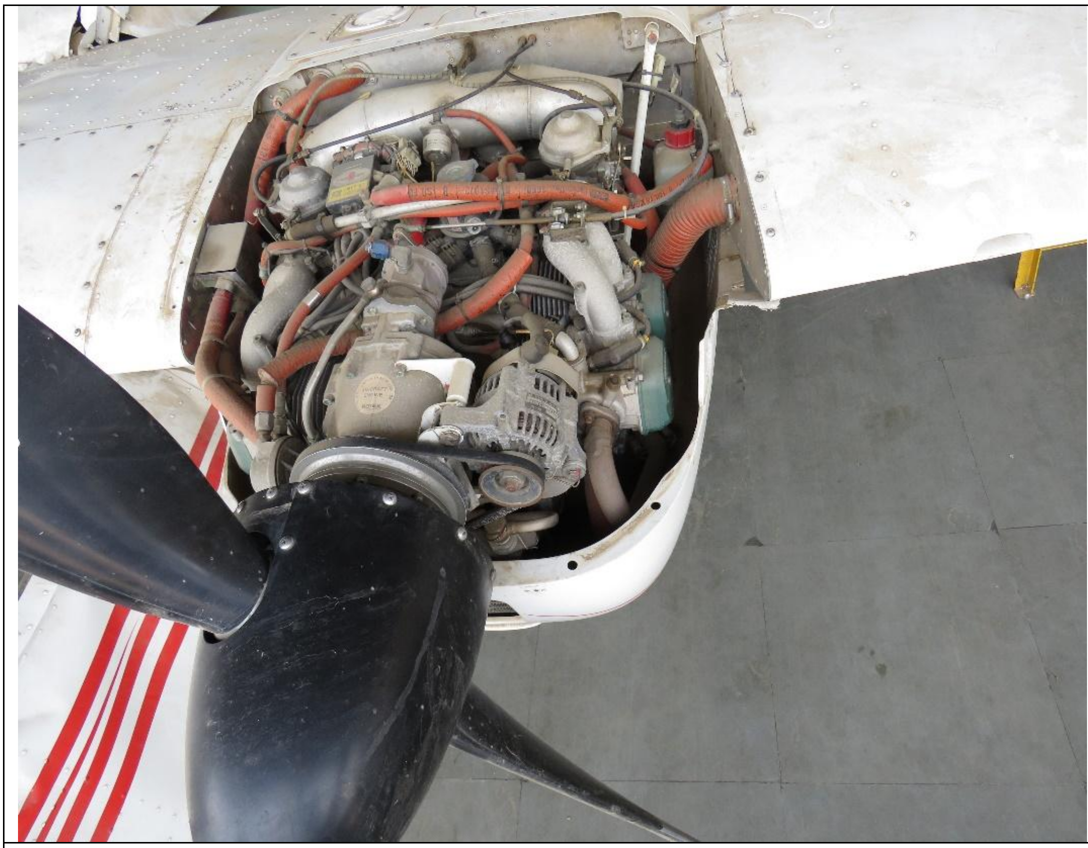
team to check whether propellers could be rotated by hand and simultaneously verify that no internal damage is present. It was observed that the rotation of the propeller on left side is smoother than the right side of the engine.

8. The left side Propeller was turned by hand while ignition System was in the off Position. During rotation, no rubbing or sticking sound was noticed. The Propeller started rotating normally without any abnormal sound from the Engine.
9. Based on the checks and inspections carried out by the investigation team, it was concluded that the engine could be started in this condition as no significant abnormality was observed during the engine inspection.
10. Thereafter, it was decided to fill the oil tank and fuel tank respectively with the same grade of oil and fuel specified by the OEM for both the engines.
11. As per OEM guidelines, all the precautions were taken, and handheld fire extinguishers were placed near the engine before powering the engine.
12. Thereafter, External power source was connected to supply the electrical power to run the engine. Initially the engine did not start and therefore cart battery was replaced with a fully charged Battery.
13. After confirming and taking all the precautions, again team tried to start the Engine. After cranking, the left engine started for a few seconds but immediately the power was cut off to stop the engine. This confirmed that the left engine was serviceable.
14. This whole exercise was carried out in the same manner for the right engine also but as the propeller of right engine was not smoothly rotating therefore, the wing was supported on trussels and thereafter power was supplied through external cart. The Right engine also started, which showed that it was also serviceable.

Inference: This exercise has established that both engines were serviceable when loss of power for both the engines was reported by the pilot. The following factors could have contributed to the loss of power:

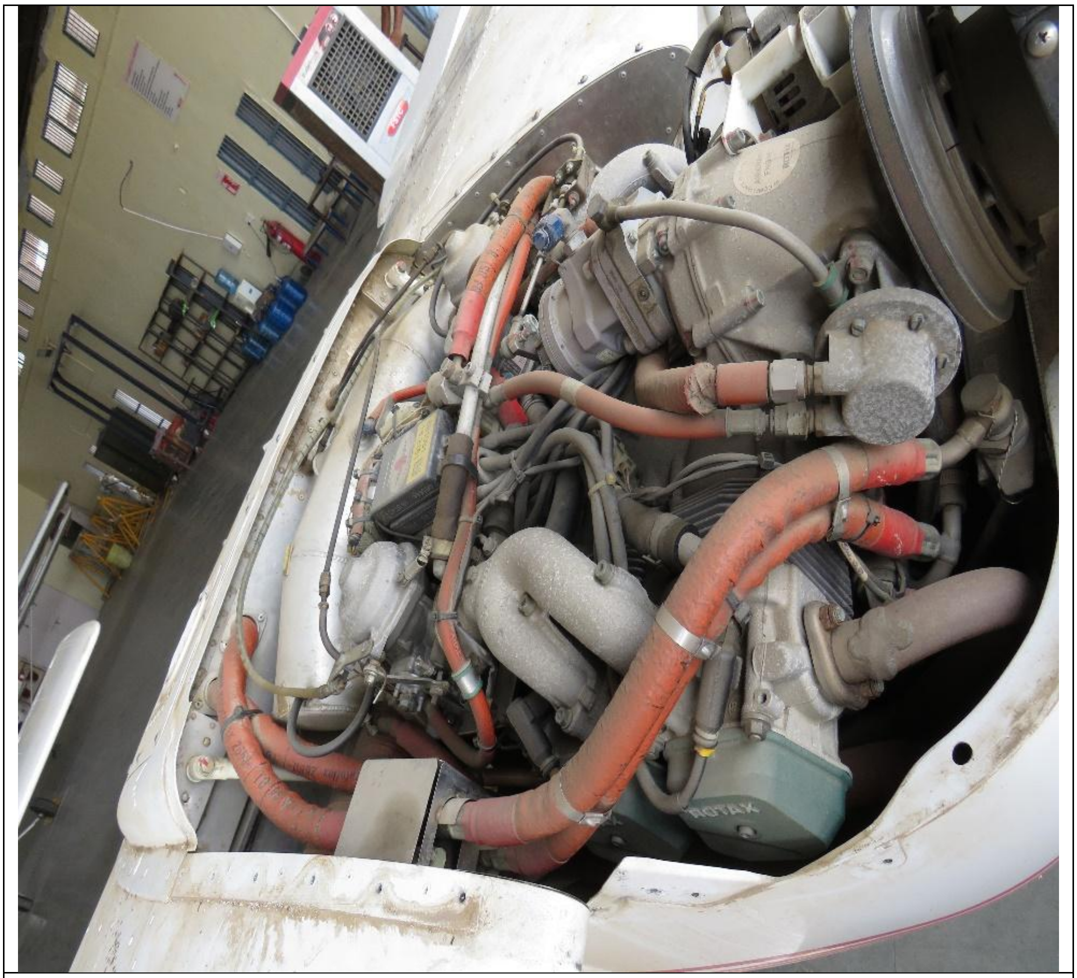
1. Non adherence to OEM SOP
2. Using non-specified fuel
3. Formation of vapor lock

Relevant photographs are shown below.



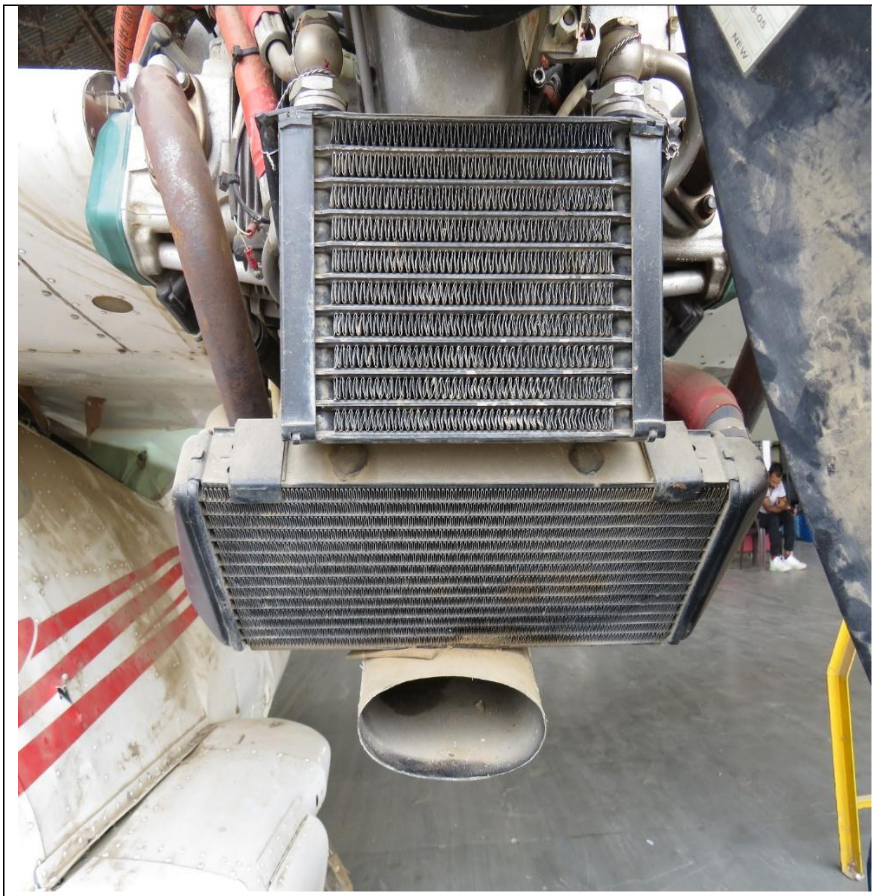
1. VISUAL INSPECTION OF LH ENGINE AFTER REMOVAL OF UPPER ENGINE COWLING

2. LEFT VIEW OF LH ENGINE



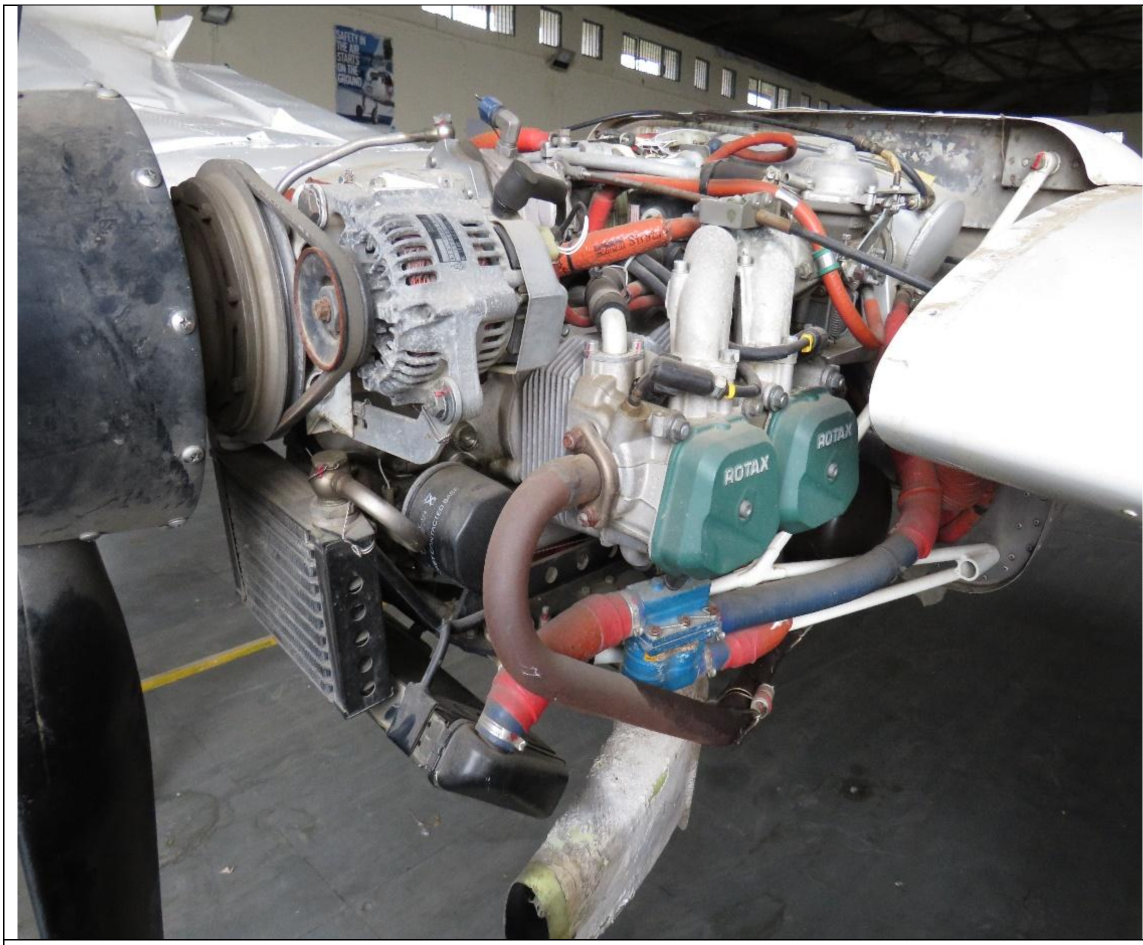
3. **RIGHT VIEW OF LH ENGINE**

4. **TOP VIEW OF LH ENGINE**



5. AIR INTAKE FILTER

6. RIGHT ENGINE FRONT VIEW



7. LEFT SIDE VIEW OF RH ENGINE AFTER REMOVAL OF ENGINE COWLING

8.TOP VIEW OF RH ENGINE