Final investigation report on accident involving Diamond DA-40 aircraft VT-FGC belonging to M/s IGRUA on 13 June 2022 near Fursatganj, Uttar Pradesh.

Aircraft Accident Investigation Bureau

Government of India

Ministry of Civil Aviation

FOREWORD

In accordance with Annex 13 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.

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GLOSSARY

AAIB	Aircraft Accident Investigation Bureau
AD	Airworthiness Directives
A/F	Airframe
AMSL	Above Mean Sea Level
ARC	Airworthiness Review Certificate
ATC	Air Traffic Control
AUW	All Up Weight
C of A	Certificate of Airworthiness
CAR	Civil Aviation Requirements
CPL	Commercial Pilot Licence
DGCA	Directorate General of Civil Aviation
ELT	Emergency Locator Transmitter
FDTL	Flight Duty Time Limitation
FTO	Flying Training Organisation
GFRP	Glass Fibre Reinforced Plastic
Hrs	Hours
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
IMD	India Meteorological Department
Kt	Knots
MEL	Minimum Equipment List
MLG	Main Landing Gear
MTOW	Maximum Take Off Weight
NLG	Nose Landing Gear
NM	Nautical Miles
NOSIG	Not Significant
NTSB	National Transportation Safety Board
PIC	Pilot in Command
RTR	Radio Telephony Restricted
SB	Service Bulletin
SCT	Scattered
TSN	Time Since New
TSO	Time Since Overhaul
VHF	Very High Frequency
VRB	Variable
UTC	Universal Time Coordinated

SYNOPSIS

On 13 June 2022, DA-40 aircraft VT-FGC belonging to M/s IGRUA was involved in an accident near Fursatganj Airfield, UP while operating a training flight. The aircraft was under the command of a student pilot holding a valid student pilot license.

After 3rd Solo Check, the Student Pilot was released by the Flying Instructor for his 3rd Solo Sortie. Aircraft took off from runway 27 at 0455 UTC. During the second circuit, Student pilot carried out an intentional go around which was the part of his planned exercise. Thereafter, trainee completed second circuit and a uneventful full stop landing was made. Subsequently, Student pilot prepared for his 3rd Circuit and Landing Exercise. During this exercise, while the aircraft was on early final leg and commencing approach to runway 27, the local ATC instructed the aircraft for go around.

The Student Pilot executed a go around and subsequently, turned for early cross wind and downwind legs. After crossing the runway dumbbell area and towards the end of downwind leg, the student pilot transmitted "Experiencing Engine Failure".

The engine RPM started dropping and therefore, student pilot had decided to make a forced landing. Subsequently, Emergency checklist was followed and a forced landing was carried out in an open agricultural field. The aircraft was substantially damaged during the forced landing but the trainee pilot did not receive any injury in the accident.

Director General, Aircraft Accident Investigation Bureau vide order No. INV.11011/10/2022- AAIB dated 22 June 2022 nominated Shri Dinesh Kumar, Assistant Director, AAIB as Investigator-In-Charge (IIC) to investigate and determine the probable cause(s) and contributory factor(s) leading to the accident. Shri K. S. Muthukrishnan, Consultant, AAIB was assigned on OJT.
Initial notification of the occurrence was sent to concerned states along with ICAO as per 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.

SUMMARY

Aircraft and Accident details of Diamond DA-40Aircraft VT-FGC on 13th June 2022			
1.	**Aircraft**	**Type**	Diamond DA-40
		Nationality	Indian
		Registration	VT-FGC
2.	**Owner & Operator**		M/s Indira Gandhi Rashtriya Uran Akademi (IGRUA)
3.	**No. of Persons on-board**		01 (Student Pilot)
4.	**Date & Time of Accident**		13 June 2022at 0508 UTC
5.	**Place of Accident**		Near Fursatganj Airfield
6.	**Co-ordinates of Accident Site**		Lat: 26° 22’ 95’’ N Long: 81° 44’ 04’’ E
7.	**Last point of Departure**		Fursatganj Airfield
8.	**Intended landing place**		Fursatganj Airfield
9.	**Type of Operation**		Circuit & Landing Exercise
10.	**Type of Occurrence**		Forced landing
11.	**Extent of Injuries**		Nil

(All the timings in this report are in UTC unless otherwise specified)

1. FACTUAL INFORMATION

1.1 History of Flight

On 13th June 2022, as per organization's prevailing practice, all the trainees scheduled for training flights, assembled at FOC at 2315 UTC (0445 IST). The student pilot had also reported at the same time for the morning briefings. At 2330 UTC, the student pilot received the METARs, satellite images, and radar images of the local flying area and its vicinity.

The Diamond DA-40 aircraft VT-FGC, stationed at Fursatganj airfield, was scheduled for training flight once it was released by maintenance engineer at 2345 UTC (0515 IST). The first sortie of the day for VT-FGC was planned as a cross country training flight. During the training flight, the aircraft was flown by another student pilot and no defect or abnormality was reported.

At approximately 0300 UTC, the student pilot reported to the Flight Instructor assigned to conduct the check flight. Subsequently, the Instructor briefed the trainee and prepared him for his third solo release sortie.

The student pilot checked the logbook entries as well as release certificate before proceeding to the aircraft. Thereafter, the student pilot followed the checklist and carried out a walk-around inspection accordingly. Subsequently, the Instructor had also performed the final walk-around inspection to assess the overall condition of the aircraft.

According to the Student Pilot, after starting the engine, cockpit gauges were observed, and all parameters, including those of the engine, were found within limits. Subsequently, the trainee requested taxi clearance. ATC cleared the aircraft for taxiing and instructed it to hold at holding point 'Delta'.

After reaching holding point 'Delta', the student pilot carried out the 'before takeoff' checks and requested departure clearance from ATC. The aircraft lined up on runway 27 following clearance from the Fursatganj ATC and took off at 0311 UTC. During this sortie, the student pilot performed adverse weather circuits and normal circuit & landing exercises under the supervision of the Flight Instructor. After completing the sortie, the aircraft landed at Fursatganj airfield and vacated the runway via holding point 'Bravo'. Thereafter, the student pilot was released for his 3rd solo sortie, as his performance was satisfactory.

Before leaving the aircraft, the Flight Instructor briefed the student pilot for his next solo sortie. As per the company SOP, after disembarking the aircraft, the instructor proceeded to the ATC tower to supervise and monitor the sorties from there.

According to the student pilot's statement, all the checklists were once again followed before the aircraft took off at approximately 0428 UTC.

While on finals, the student pilot communicated to Fursatganj ATC "Tower, VGC, on finals for intentional go around" and executed a planned go-around. After completing the circuit, the aircraft landed uneventfully and vacated the runway via holding point Bravo. Thereafter, the aircraft was again cleared by ATC to proceed to holding point Echo for the 3rd Circuit and Landing Exercise as planned.

Accident Sortie

At 0455 UTC, the aircraft took off again after receiving ATC clearance. During this circuit, while the aircraft was on the final leg, ATC instructed the student pilot to initiate a go-around as another aircraft had already lined up for takeoff from runway 27. The student pilot executed the go-around by adding power, and once a positive climb rate was achieved, flaps were retracted at about 660 ft. Thereafter, the trainee reported turning crosswind at 1.7 DME. While the aircraft was at the end of the downwind leg at a circuit altitude of 1400 feet, approximately after crossing runway 27 Dumbbell, the student pilot noticed the engine rpm and noise dropping. However, the student pilot did not feel any vibrations in the cockpit.

The student pilot took immediate action by attempting to restart the engine by following the emergency checklist procedures, but the engine did not respond. Once it was established by the trainee that engine is not responding, he transmitted on the radio 'Experiencing Engine Failure.'

Thereafter, the student pilot switched to the company frequency anticipating an early response on it. One Dy. CFI of the organization, who was flying another aircraft (VT-IGQ), responded to the transmission. The Dy. CFI instructed the student pilot to 'check all three levers fully forward' and 'open the alternate air,' while advising the trainee to look for an open field. Meanwhile, as the student pilot searched for an open field, the engine RPM continued to drop, with the last observed RPM being around 1050 rpm. Eventually, the aircraft lost contact with both the ATC tower and the Dy. CFI.

The student pilot was able to identify an open field that was clear of obstacles such as high-tension wires. The student pilot followed the Emergency Checklist and accordingly turned OFF the fuel pump, lifted the fuel tank selector pin, and set the throttle and mixture lever to the idle/cut-off position

While the aircraft was coming for a forced landing, the student pilot observed a few trees in its approach path. Although the aircraft was maneuvered to avoid those trees, it still impacted a few of them. At 0508 UTC, the aircraft made contact with the ground and subsequently came to a rest.

Following the crash, the student pilot had promptly released the seat belt harness and made a rapid egress from the aircraft. A nearby eye witness immediately approached the student pilot to offer assistance. The student pilot requested for his mobile phone and thereafter, informed the operations department of the organization about the accident.

Student pilot did not receive any injury in the accident. However, the aircraft, due to impact forces, was substantially damaged. Further, ELT of the aircraft did not activate and no signal was transmitted by the unit during this accident.

Figure 1: Accident Site

1.2 Injuries to persons

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

1.3 Damage to Aircraft

The aircraft was substantially damaged.

1.4 Other damage

Few tree branches and stems were found broken due to aircraft's impact.

1.5 Personnel Information

1.5.1 Student Pilot

Nationality	Indian
Age	25 years
Date of Joining the Organisation	July 2021
License Type	SPL
Date of issue	01.02.2022
Valid up to	31.01.2027
Category	Aeroplane
Aircraft Rating	DA-40
Date of Medical Exam	13.11.2020 (Class-II Medical)

Medical Validity	12.11.2022
FRTOL Date of Issue/Validity	04.04.2022/03.04.2032
RTR Date of Issue/Validity	N/A
Total Flying Experience	28:05 Hrs.
Hours Flown on Type	28:05 Hrs.
Experience as PIC on Type	00:40 Hrs.
Hours flown in last 365 days	28:05 Hrs.
Hours flown in last 180 days	28:05 Hrs.
Hours flown in last 90 days	19:45 Hrs.
Hours flown in last 30 days	14:55 Hrs.
Hours flown in last 7 days	03:50 Hrs.
Hours flown in last 24Hrs.	01:15 Hrs.
Previous accident/incident history	Nil

The first solo release check was carried out by the instructor on 10 May 2022, to assess the flying skills of the student pilot before allowing him on his first solo sortie. Based on his performance, the trainee was advised to repeat his first solo check. Subsequently, on May 23, 2022, he underwent another first solo check. During this check, the instructor asked the trainee to report for his 1st Solo Sortie after completing corrective sorties. Meanwhile, more emphasis was given to the student pilot's training in the areas where he was lacking. Once the performance of the student pilot was found satisfactory during the Pre-Solo check, he was cleared for his first solo flight on 2 June 2022, after 23:55 hrs of dual supervisory flying.

Thereafter, the student pilot went for 2nd Solo check on 7th June 2022 and was released for his 2nd Solo sortie after his performance was found satisfactory.

1.6 Aircraft Information

1.6.1 General Information: DA-40 aircraft

The aircraft is manufactured by M/s Diamond Aircraft Industries Inc., Canada, and is equipped with variable pitch propeller, T- tail, low wing & fixed tricycle landing gear. It is a semi monocoque, composite aircraft having GFRP structure.

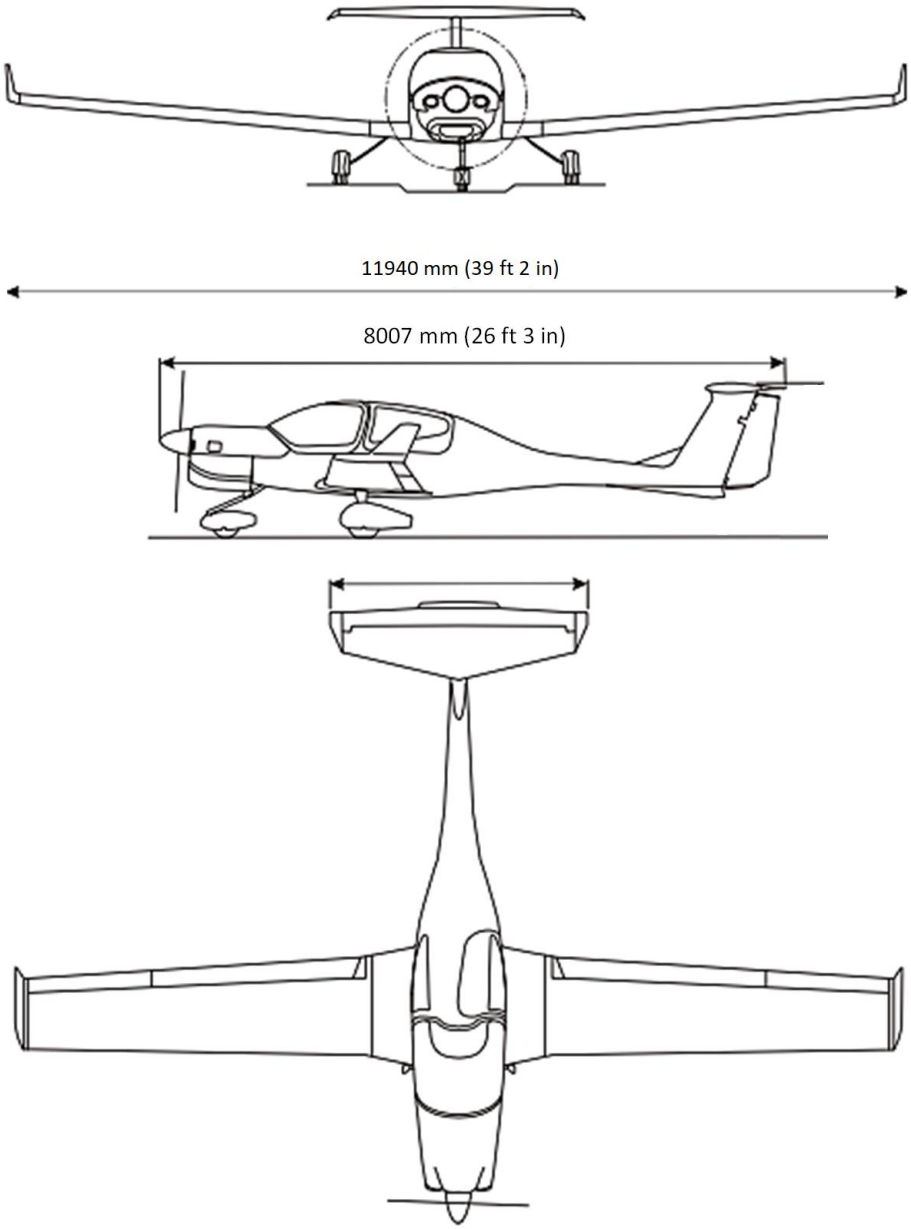


Figure 2: Aircraft Dimensions

Aircraft is powered by Lycoming IO-360-M1A engine which is a fuel injected, direct drive, four cylinders, horizontally opposed, air cooled normally aspirated engine. The engine has a rated maximum continuous power of 180 hp at 2700 RPM at Standard Sea level conditions.

The aircraft power generation has two main Systems:

a) Air intake system. This system supplies air from the air inlet via induction filter to the engine intake manifold.

b) Engine fuel system. The engine fuel system takes fuel from the airplane fuel system and injects it into the cylinders.

The DA 40 has a Lycoming 4-cylinder, horizontally opposed, direct drive engine. The engine type is IO-360-M1A. The engine has a wet sump oil system. The IO-360-M1A is air cooled and has a fuel injector system. The propeller turns in a clockwise direction when viewed form the cockpit.

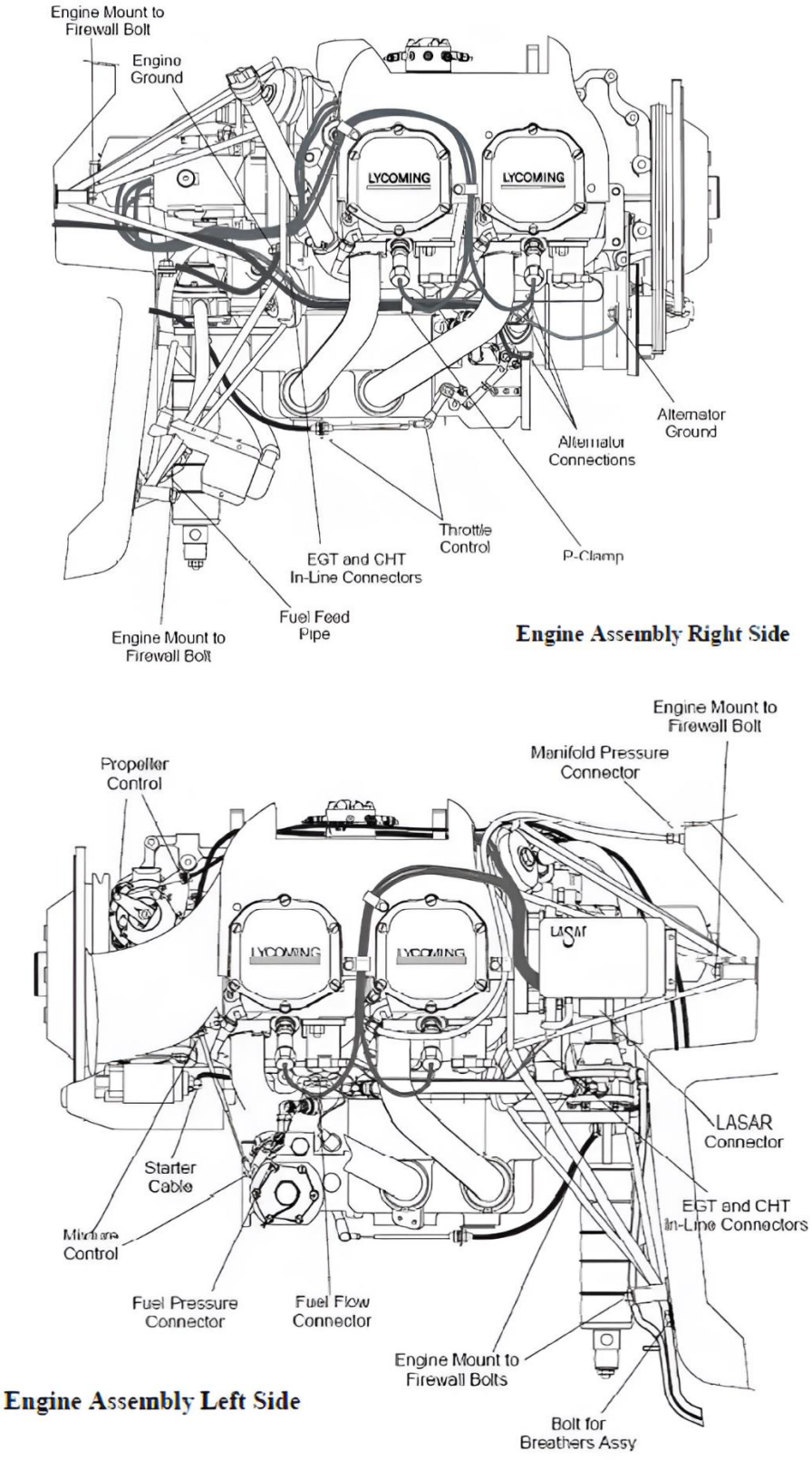


Figure 3: Engine Left and Right View

Engine air intake. This intake is located in the lower centre of the cowling and supplies air to the engine air filter.

The bottom cowling has the air intakes. The left intake gives cooling air for the engine. The right intake supplies air for the engine, the oil cooler, cabin heating, battery cooling, and alternator cooling.

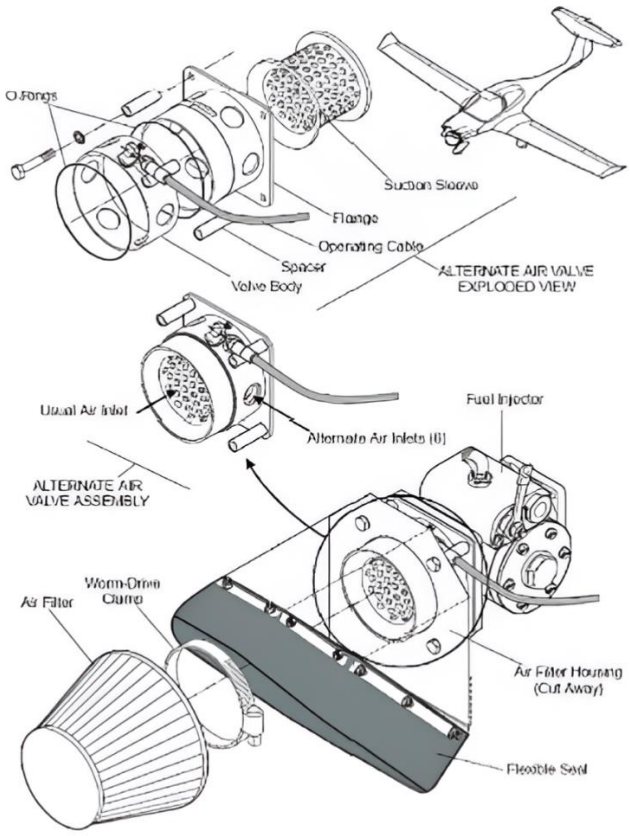
I. ALTERNATE AIR

In the event of the loss of manifold pressure because of icing or blocking of the air filter, there is the possibility of drawing air from the engine compartment. The operating lever for alternate air is located under the Instrument panel to the left of the center console. To open alternate air the lever is pulled to the rear. Normally, alternate air is closed, with the lever in the forward position.

Alternate Air Valve Assembly

The alternate air valve assembly has a valve body which has 6 air inlet holes around its circumference. A Bowden cable attaches to the valve body and rotates the valve body inside the valve flange. O-ring seals locates at each end of the valve body to make a seal between the valve body and the valve flange.

The valve flange has 6 air inlet holes drilled around its circumference. A suction sleeve locates inside the valve flange and passes through the center of the alternate air valve assembly.



Engine Air Filter and Alternate Air Intake

Figure 4: Engine Alternate Air System

When the alternate air control lever in the cockpit is moved to the alternate air position, the Bowden cable rotates the valve body to align the holes in the valve body with the holes in the flanged housing. Warm air from the engine bay will now flow through the alternate air valve into the fuel injector. The

alternate air valve can be selected to the alternate air position to supply warm air for anti-icing or to maintain the air supply should the air filter become blocked. The alternate air supply is not filtered.

II. FUEL SYSTEM

The total usable fuel capacity of the fuel system is 152 liters (40 US gal) with the Standard Tank. Two pumps supply fuel to the engine and a filter gives protection to sensitive components. The pilot controls the fuel system with a selector valve and a switch for the electric fuel pump. A fuel quantity indicator shows the quantity of fuel in the left tanks and in the right tanks.

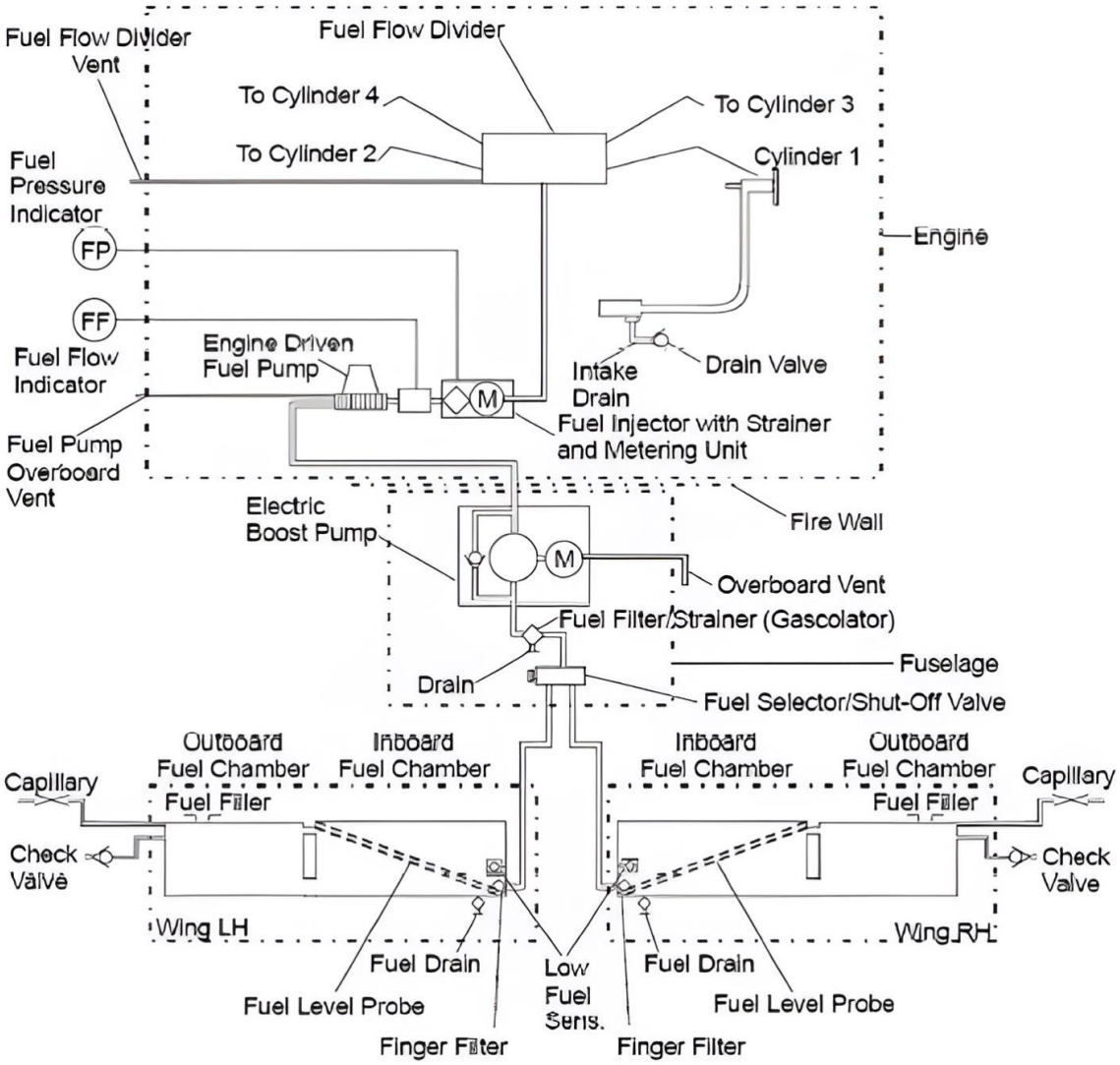


Figure 5: Fuel System Schematic Diagram

a. Fuel Distribution System

The fuel distribution system supplies fuel from the fuel tanks to the engine.

b. Fuel Selector/Shut-Off Valve

The fuel selector/shut-off valve is located below the cockpit floor. The selector valve is a three-way valve. A long shaft connects the valve to a selector control lever which is located in the cockpit. The selector control lever is mounted in the center console, aft of the engine control assembly. If the control lever is set to LEFT then only the left wing tanks will supply fuel. If selected to RIGHT then only the right-wing tanks will supply fuel. The OFF position is reached by turning the selector to the right

while pulling up the safety catch of the fuel tank selector. This is to ensure that an OFF selection is not made unintentionally.

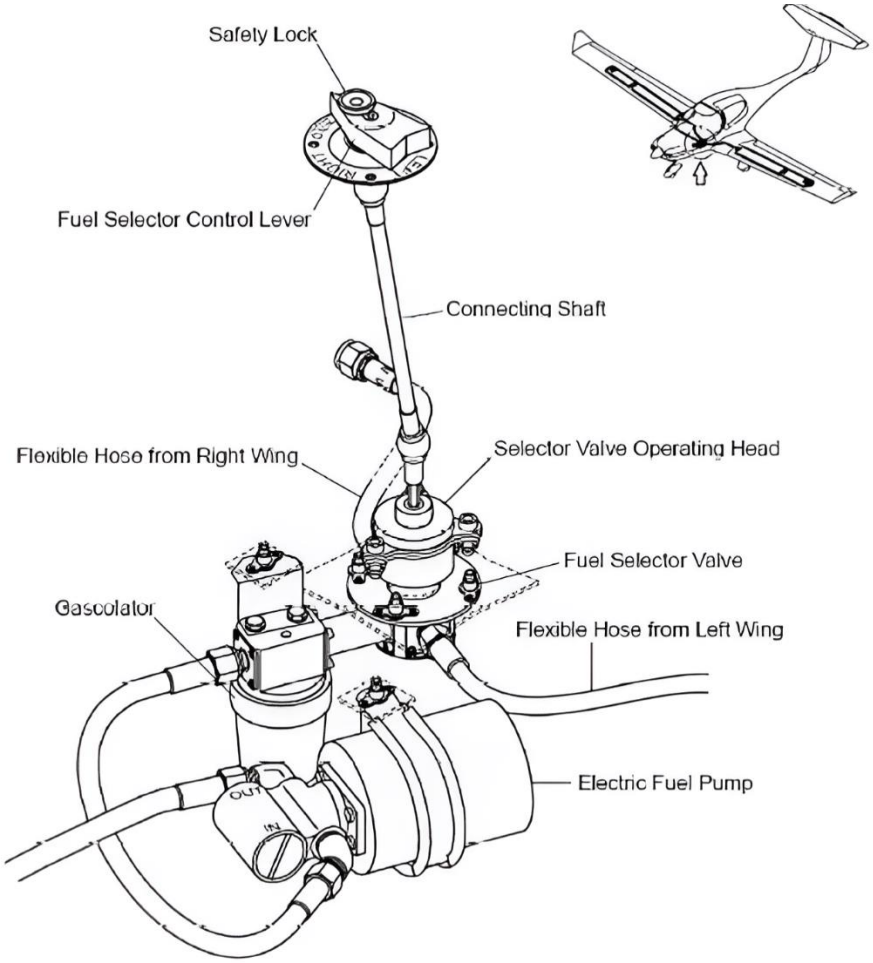


Figure 6: Fuel Distribution System

c. Fuel Pumps

The fuel system is equipped with a mechanical and an electrical fuel pump. The mechanical pump provides for the normal fuel supply.

The electrical fuel pump is provided as an auxiliary and emergency pump which does not operate under normal circumstances. It is checked during engine start, and is used as a safety back-up during take-off and landing, as well as when switching fuel tanks.

d. Electric Fuel Pump (Booster Pump)

The electric fuel pump is located in the fuselage, below the cockpit floor. Electrical power is supplied from the main electrical bus.

A switch in the lower left side of the instrument panel controls the fuel pump. A five Amp circuit-breaker protects the fuel pump electrical system. The pump is a high-pressure rotary pump. It supplies fuel to the engine if the engine driven fuel pump fails.

III. OPERATING CONTROLS

The engine performance is controlled by means of three levers: throttle, RPM lever and mixture control lever, situated together as a group on the large center console (also referred to as the throttle quadrant). Front and rear are defined in relation to the direction of flight.

a. Throttle

Position of Lever: Left hand lever with large, black knob.

This lever is used to set the manifold pressure (MP). When the throttle is furthest forward, the engine is being provided with extra fuel for high performance settings.

Lever forward (MAX PWR)	=	Full throttle, higher MP
Lever to rear (IDLE)	=	Idle, low MP

High manifold pressure means that a large quantity of fuel-air mixture is being supplied to the engine, while low manifold pressure means a lesser quantity of fuel-air mixture is being supplied.

b. RPM Lever

Position of Lever: Central lever with blue handle.

Lever forward (HIGH RPM)	=	High RPM, fine pitch
Lever to rear (LOW RPM)	=	Low RPM, coarse pitch

By means of this lever the propeller governor controls the propeller pitch and thus engine RPM (= propeller RPM). A selected RPM is held constant by the governor independent of the airspeed and the throttle setting ('Constant Speed').

c. Mixture Control Lever

Position of Lever: Right hand lever with Red Handle.

This lever is used to set the proportions in the fuel-air mixture which is supplied to the engine.

Lever forward (RICH) = Mixture rich (in fuel)
Lever to rear (LEAN) = Mixture lean (in fuel)

If the lever is at the forward stop, extra fuel is being supplied to the engine which at higher performance settings contributes to engine cooling.

IV. GARMIN SYSTEM (G1000 SYSTEM)

DA-40 aircraft having glass cockpit is installed with GARMIN G1000 System. For normal operations the left display is the primary flight display (PFD) and the right is the multi-function display (MFD). Both displays are similar, except the autopilot control buttons. The engine control unit (ECU) provides most of the indications for the engine. After powering ON of the electrical system, 52 parameters are captured by G1000 system.

Figure 7: Garmin System (DA-40 Cockpit)

1.6.2 Aircraft Specific Information (VT-FGC)

The aircraft is registered under category 'Normal' with Sub Category 'Passenger' as per its C of A.

Aircraft Model	DIAMOND DA-40
MSN	40.1005
Year of Manufacturer	2008
Name of Owner	INDIRA GANDHI RASHTRIYA URAN AKADEMI (IGRUA)
C of R	3978
C of A	6087
Category	NORMAL
ARC issued on	17.03.2022
ARC valid up to	21.03.2023
Aircraft Empty Weight	812.10 Kg.
Maximum Takeoff weight	1200.00 Kg.
Date of Aircraft weighment	18.09.2008
Operating Empty Weight	897.10 Kg.
Max Usable Fuel	110.20 Kg.
Max Payload with full fuel	192.70 Kg.
Total Aircraft Hours	10057:24 Hrs.
Last major inspection	2000Hrs./12Years approved inspection schedule
List of Repairs carried out after last major inspection till date of accident	NIL
Engine Type	LYCOMING IO360M1A
Date of Manufacture	05.08.2008
Engine Sl. No.	L-34422-51E
Last major inspection	2000Hrs./12 Years approved inspection schedule
List of Repairs carried out after last major inspection till date of accident:	NIL
Total Engine Hours/Cycles	87:07 hrs. (TSO)
Aero mobile License	31.12.2023
AD, SB, Modification complied	All Applicable AD,SB, Modifications were complied

The involved engine was previously installed on another aircraft i.e. VT-FGJ. On 07.07.2021, the involved engine bearing Sl. No. L-34422-51E which was due for overhaul at 2000 hrs was removed from VT-FGJ at 1998:45 Engine hrs. (TSO) and 7978:59 hrs. (TSN).

During removal the following components were due for maintenance as per the log entries:

Sl. No	Component	P/N	S/N	TSN	TSO	Remarks
1.	Fuel Injector	2576568	75HB4701	1998:45	--------	Due for O/H
2.	Fuel Manifold	2576564-1	AH69306	1998:45	---------	Due for O/H
3.	Propeller Governor	S-1-6	G 132 NJ	6550:38	1998:45	Due for O/H
4.	Engine mount bolt	AN7-43A & 44A	----------	---------	1998:45	Due for NDT
5.	Engine vibration isolator	J-9613-58	----------	---------	1998:45	Due for replacement

Table 1: Components due for maintenance

M/s Varman Aviation Pvt Ltd (Engine Overhauling Agency) received the engine for overhauling on 18.12.2021 as it was due for scheduled maintenance (2000 hrs). After overhaul, the engine was released for service on 6 April 2022 once all the parameters were found within in the limits.

As per the Engine Log book records, the bonded store of the Overhauling agency had released the following items and installed on the Engine during the overhaul:

Sl. No	Components	P/N	Quantity
1.	Cylinder kit Assembly Sl. No 1) 38210077191 2) 40210077221 3) 40210077238 4) 40210077912	05K21104	04
2.	Rocker arm bushing	74637	08
3.	Ring gear starter	72566	01
4.	Spring, Shroud tube	LW-14995	04
5.	Shaft valve rocker	LW13790	03
6.	Push rod	15F28835-30	02
7.	Drive stud	STD-1901	02
8.	Baffle Assembly Inter cylinder	75339	01
9.	Baffle Assembly Inter cylinder	LW- 13389	01

Table 2: Items released by Bonded Store

The engine was released with a note that 'Exhaust valves' need to be inspected at 1000 hrs. (TSO) or if valve sticking is suspected as per SB388C and follow SI 1425A to reduce the possibility of valve sticking.

During overhauling of engine carried out at M/s Varman Aviation Pvt. Ltd., following components with 00 hrs. were installed on the involved engine:

Sl. No	Component	P/N	S/N	Hrs
1.	Fuel divider	2576564-1	A0R0N03	00:00
2.	Fuel EDP	LW-15473	2021 L 0021	00:00
3.	Ignition harness	M2989 & M2990	----------	00:00
4.	Spark plugs	REM 40 E	----------	00:00

Table 3: Components with 00 hrs. fitted on the Engine

Once the overhauled engine was received by M/s IGRUA, this engine was fitted on VT-FGC on 24.04.22 along with additional serviceable components and their details are as follows:

Sl.No	Component	P/N	S/N	TSN	TSO	Remarks
1	Fuel Injector	2576568-1	750J5V04	799:17	--	Serviceable ex-Engine L-34490-51E
2	Alternator	ALU8521 LS	H-V062633	570:13	--	
3	Starter	19-24 LS	H-1011573	1071:51	--	
4	Prop governor	S-1-6	G203NJ	5062:58	00:00	FAA form 8130-3
5	Magneto	4347	19060949	1306:42	197:01	Serviceable ex-Engine L-34490-51E
6	Magneto	4370	12111589	1301:09	225:11	
7	Oil radiator	DAI9079-00-01	1450	9970:17	00:00	serviceable

Table 4: Components fitted by IGRUA

After the engine was installed, ground run was performed on 12.05.22. Thereafter, the test flight of the aircraft was performed on 17.05.22 after 2000hrs/ 12 years inspection carried out on the aircraft.

After overhaul, the oil filter which was due at 25 hrs. was also changed on 31.05.2022 at 24:35 hrs.

The scheduled inspection (50 hrs.) for the engine was carried out on 06.06.22 at 49:24hrs. (TSO) and 10019:41 A/F hrs. Afterward, the engine accumulated 87:07 hrs. (TSO) before the accident occurred."

ELT annual inspection and self-test was carried out on 29.02.2022 at 9695:35 A/F hrs. The last ELT self-test was carried out on 03.06.2022.

Scrutiny of the Technical Log Book and Pilot Defect Report (PDR) register revealed that there were no snag pending on the aircraft prior to the accident. The aircraft and its engine was maintained as per the Approved Maintenance Programme approved by DGCA. All concerned Airworthiness Directive, mandatory Service Bulletins, and DGCA Mandatory Modification on this aircraft and its engine have been complied with as on date of accident.

1.7 Meteorological Information

Fursatganj airfield is an uncontrolled airfield and therefore, does not have any MET facility at airport. However, the organization has a setup to measure the current surface winds with vector, ambient temperature and dew point. The weather information for Fursatganj airfield as per the METAR recorded on the date of accident is as below:

Time (UTC)	Winds (Deg/Knots)	Visibility (Meters)	QNH (Hpa/ In hg)	Temp (˚C)	DP (˚C)	Weather/ Clouds
0401	270˚/04	5000	1002/2959	38	19	HZ/ NSC
0501	280˚/05	5000	1001/2958	40	19	HZ/ NSC

Table 5: Meteorological Data

1.8 Navigational Aids

Following Navigational Aids are available at IGRUA (Fursatganj Airfield).

(a) VOR/DME
(b) Localiser
(c) PAPI on both runway
(d) Wind Sock

1.9 Communication

The aircraft was fitted with VHF radio set which catered for communication between crew and ATC. During circuit flying, student pilot was in two-way positive communication with local ATC, manned by IGRUA personnel. However, no recording facility is available at Fursatganj ATC.

The ATC at Fursatganj airfield has following dedicated frequencies for VHF communication:

Tower frequency : 129.95 MHz
Approach frequency : 122.65 MHz

1.10 Aerodrome information

The Fursatganj airfield which is owned and maintained by IGRIUA with ICAO Code VERB. It has one airstrip with orientation 27/09 and its elevation is 359 feet (AMSL). Rwy 27 is a Precision Instrument Approach runway whereas the Rwy 09 is a non-Precision Instrument Approach Runway.

Figure 8: Fursatganj airfield

The other information about the aerodrome is given below:

Aerodrome reference point : 26˚ 15.03’ N / 81˚ 22.85’E
Runway dimension : 5800 x 138 feet

1.11 Flight Recorders

Neither CVR nor DFDR was installed on the aircraft. DGCA’s Civil Aviation Regulations does not mandate the same as per CAR Section 2 Series I Part V. However, the aircraft is fitted with a Multi-Function Display (MFD) which has a provision to insert an external secure digital data card (SD). This SD card is an ultra-flash memory which has a provision to record vital aircraft parameters.

The data retrieved from the SD card was shared with the OEM to analyze the raw data. Based on the review of Garmin data for last 02 minute of flight, it was concluded by OEM that the RPM was steady at around 1000 rpm or less showing glide type flight with a reduction in fuel flow. However, the reason for such behavior of the engine during the training flight was not confirmed by the OEM.

1.12 Wreckage and Impact Information

After ATC instruction, the student pilot initiated a go-around and the path followed by the aircraft during the final leg is shown in Figure No. 9. While the aircraft was about to join the base leg, the trainee observed a sudden drop in engine RPM. Consequently, the aircraft also started losing height continuously. A slight deviation towards right was observed as the aircraft started approaching forced landing site.

Figure 9: Aircraft profile (Final leg)

While carrying out the emergency landing, the left wing of the aircraft initially made contact with the tree’s branches. Subsequently, the lower nose section of the aircraft hit a tree limb, as evident from the impact mark observed on the engine's air filter.

Figure 10: Air Filter

During the accident, the other sections of the aircraft also collided with trees; consequently, a few broken composite parts found entangled in the tree branches, while other few detached pieces were found scattered on the ground but mainly beneath the trees.

The left wing of the aircraft got severely damaged indicating that this surface experienced the highest impact during the crash. Further, during collision, trees acted as a pivot which resulted into aircraft's directional change as well as momentum. As much of the momentum was absorbed, therefore it caused a significant reduction in aircraft's forward acceleration and subsequent impact with the ground was less severe.

Figure 11: Location of trees (obstacles)

After collision, aircraft's attitude further changed, causing both the left wing and the nose landing gear to contact the ground simultaneously. As the aircraft landed in nose down attitude, one of the propeller blades also struck the ground and sustained a bend towards its tip section. Further, the nose landing gear sheared off from strut area. The left main landing gear strut was also found bent revealing that aircraft was in left roll before it impacted with ground.

After aircraft's main wheels made contact with ground, it appears that the aircraft bounced in air as landing gear tyres imprint were not observed ahead of second point of impact till the aircraft came to halt at final rest position.

Figure 12: Aircraft Final position

After the accident, the Damage assessment of the aircraft was carried out and following damages were observed:

1. PROPELLER
   - i) No. 1 blade found bent approx. 33 cm from the tip of propeller.
   - ii) No. 2 blade found slightly twisted from root to tip.

2. ENGINE
   - i) Cylinder No. 2 baffle found cracked.
   - ii) Exhaust stack found bent.
   - iii) Exhaust muffler found compressed &damaged.
   - iv) Riser pipe of exhaust cylinder No. 3 & 4 separated& found damaged from attachment clamp.
   - v) Riser pipe of exhaust cylinder No. 1 found bent.
   - vi) Induction air filter box found damaged from forward left side.
   - vii) Induction air filter found damaged from forward left side.
   - viii) Intake pipe of cylinder No. 2 & 3 are found damaged and dented.
   - ix) Engine driven fuel pump found broken.
   - x) Mixture arm found bent at injector attachment.
   - xi) Engine Mount found damaged.
   - xii) Engine shock mount found damaged & sheared out.

xiii) Alternate air cable stretched.

xiv) Dents were found on Firewall.

xv) Bottom cowling separated from aircraft and found completely damaged.

xvi) Cracks found on upper cowling.

xvii) Starter solenoid found separated from starter.

3. LANDING GEAR

i) Nose landing gear strut found broken from approx. 21 cm from forward direction.

ii) Nose landing gear elastomer pack found broken.

iii) LH Main landing gear strut found bend in forward direction.

iv) Cut marks were found on RH main wheel Tire.

4. CONTROL SURFACES & WING

i) Left Wing found fully damaged (approx. 5.1 feet from Left side of fuselage).

ii) Right Aileron Mass Balance found damaged.

iii) Rudder bracket found damaged towards right side.

iv) Dorsal fin crack marks found at 2 places.

v) Ventral fin found damaged.

5. OTHERS

i) DME Antenna found broken.

Photographs illustrating above major damages are appended as Annexure 'D' to this report.

1.13 Medical and Pathological Information

The trainee reported for the flight after taking the breath analyzer test as per DGCA requirements and tested negative. Further, trainee was again found negative during post-accident BA test carried out by the organization.

1.14 Fire

There was no pre or post impact fire.

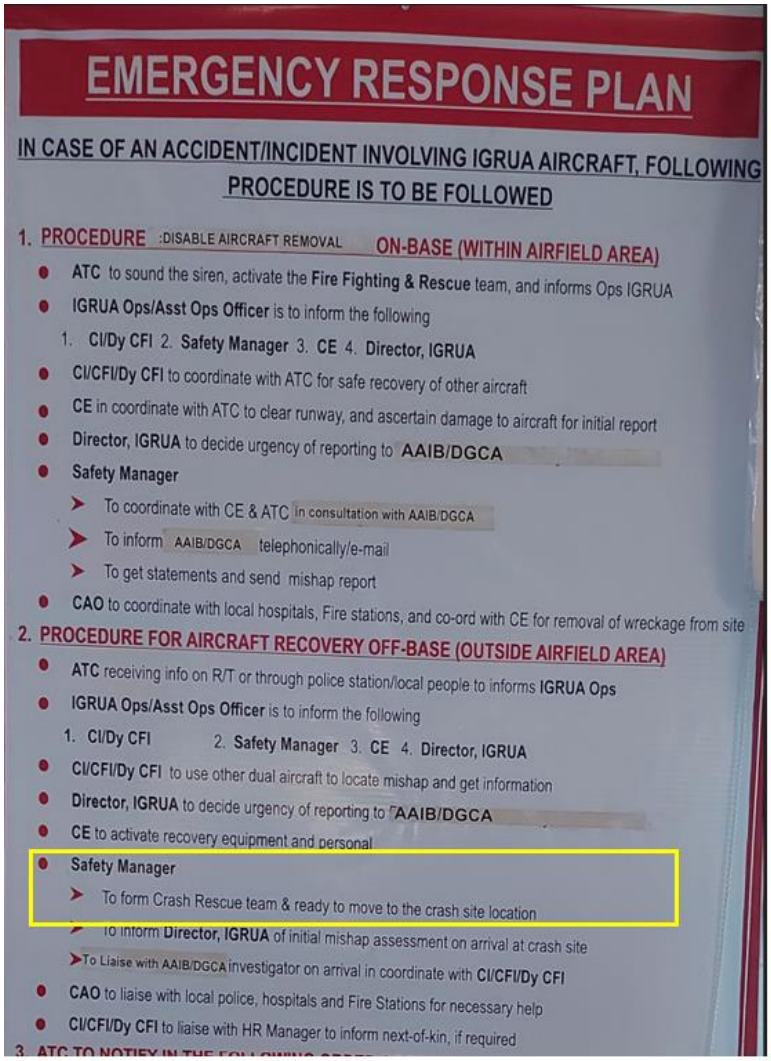
1.15 Survival Aspects

The accident was survivable.

As per the statement of the Flight Safety Manager, he was informed by CFI that DA-40 aircraft VT-FGC which was under the command of a student pilot has declared emergency.

FSM immediately rushed to the ATC where he was informed by ATCO that aircraft had made an emergency landing at approximately 4.5 Km from Fursatganj airfield. Subsequently, the Flight Safety Manager reached at the site in approximately 45 minutes. However, notwithstanding having one CFT vehicle owned and operated by IGRUA, it was never asked to accompany the rescue team deputed to accident site.

In this regard, Flight Safety Manager has stated "The road to the accident spot was very uneven and last 500 meters was agricultural field. In my opinion, the crash fire tender wouldn't have reached the spot hence the fire tender was not asked after reaching at the site". Scrutiny of Fire station log register also confirmed that CFT vehicle of the organization was not engaged in any operation on the day of accident.



EMERGENCY RESPONSE PLAN

IN CASE OF AN ACCIDENT/INCIDENT INVOLVING IGRUA AIRCRAFT, FOLLOWING PROCEDURE IS TO BE FOLLOWED

1. PROCEDURE :DISABLE AIRCRAFT REMOVAL ON-BASE (WITHIN AIRFIELD AREA)
- ATC to sound the siren, activate the Fire Fighting & Rescue team, and informs Ops IGRUA
- IGRUA Ops/Asst Ops Officer is to inform the following
  1. CI/Dy CFI 2. Safety Manager 3. CE 4. Director, IGRUA
- CI/CFI/Dy CFI to coordinate with ATC for safe recovery of other aircraft
- CE in coordinate with ATC to clear runway, and ascertain damage to aircraft for initial report
- Director, IGRUA to decide urgency of reporting to AAIB/DGCA
- Safety Manager
  - To coordinate with CE & ATC In consultation with AAIB/DGCA
  - To inform AAIB/DGCA telephonically/e-mail
  - To get statements and send mishap report
- CAO to coordinate with local hospitals, Fire stations, and co-ord with CE for removal of wreckage from site

2. PROCEDURE FOR AIRCRAFT RECOVERY OFF-BASE (OUTSIDE AIRFIELD AREA)
- ATC receiving info on R/T or through police station/local people to informs IGRUA Ops
- IGRUA Ops/Asst Ops Officer is to inform the following
  1. CI/Dy CFI 2. Safety Manager 3. CE 4. Director, IGRUA
- CI/CFI/Dy CFI to use other dual aircraft to locate mishap and get information
- Director, IGRUA to decide urgency of reporting to AAIB/DGCA
- CE to activate recovery equipment and personal
- Safety Manager
  - To form Crash Rescue team & ready to move to the crash site location
  - To inform Director, IGRUA of initial mishap assessment on arrival at crash site
  - To Liaise with AAIB/DGCA investigator on arrival in coordinate with CI/CFI/Dy CFI
- CAO to liaise with local police, hospitals and Fire Stations for necessary help
- CI/CFI/Dy CFI to liaise with HR Manager to inform next-of-kin, if required

3. ATC TO NOTIFY IN THE FOLLOWING

Figure 13: Emergency Response Plan

1.16 Tests and Research

1.16.1 Fuel System

The fuel sample from the different drain points and the engine oil from the sump was drained at the crash site and tested for conformity of the respective specification at the DGCA testing laboratory. The results implied that both the fuel and the oil sample drawn from the aircraft met the specified standards.

On 15 June 2022, Electrical fuel pump bearing Serial number 217820 Part No. 18002-B was removed from the accident aircraft and a bench check was carried out by a company's AME in presence of investigation team. During operational check, it was found in serviceable condition.

Fuel lines were examined from both LH & RH tank to booster pump, from booster pump to Engine Driven Fuel Pump (EDP), from EDP to injector and from injector to fuel manifold. All these fuel lines were found free from any type of blockages.

To check the total amount of fuel onboard, fuel was drained out from all the drain points and approximately 57 liters of fuel was found onboard after the accident.

1.16.2 ELT Serviceability Test

The Aircraft is installed with ARTEX ME 406 ELT which is a automatically activated Emergency Locator Transmitter (ELT). The ELT gets switched 'ON' by the G switch when longitudinal forces during forced landing or; manually activated via Main switch on the unit or via panel mounted switch, which is on the right side of instrument panel in flight deck.

During inspection by the concerned AME, the continuity of ELT System was examined. All the wires and switches were found intact. ELT was found secured at its installed position and no loose connection was observed. ELT Antenna area was examined and no damage was found.

As per the inspection report, no discontinuity or abnormality was found in the system. Thereafter, ELT was disconnected and brought to operator's hangar where ELT testing was carried out following permission from ATC. (Please refer Fig No. 9). To carry out the test, 4000 IFR tester was used and the result was found satisfactory.

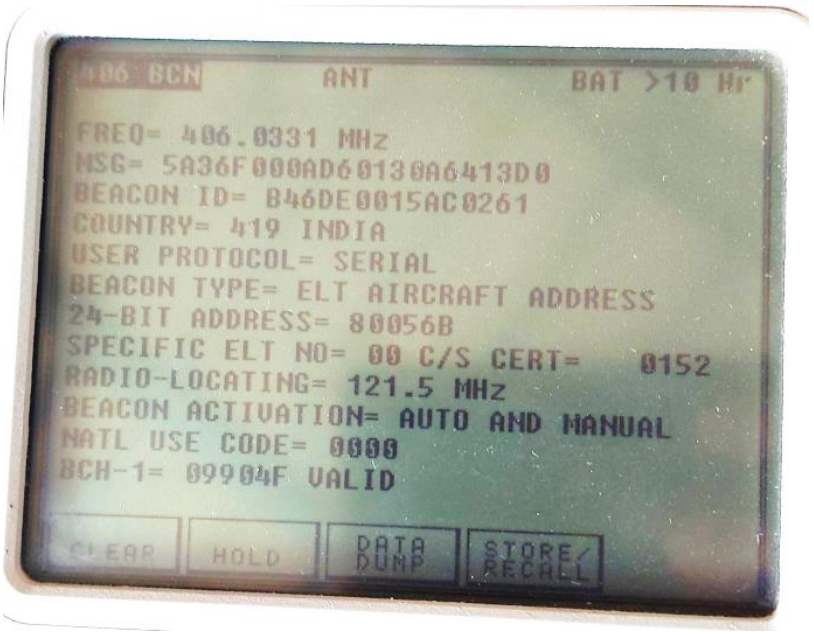


Figure 14: ELT Test Record

1.17 Organizational and management information

Indira Gandhi Rashtriya Uran Akademi (IGRUA) is a flying training Organization located at Fursatganj, District Raebareli, Uttar Pradesh. It was set up in 1985 as an autonomous body under the Ministry of Civil Aviation through its governing council being the supreme body of the organization headed by the Secretary to the Ministry of Civil Aviation. However, the flying training operations at IGRUA commenced from Oct 1986. The Chief Executive of the organization is the Director who is the Accountable Manager having both the administrative and financial control in the organization.

IGRUA is approved by DGCA as a Flying Training Organization (FTO) as per CAR Section-7, Series D, Part-I and has the approval for conducting flying training courses for CPL, PPL, SPL, IR, FIR(A) training, etc. The FTO has fleet of Trinidad TB-20, Zlin 242L, Diamond DA-40 and Diamond DA-42 aircraft. The fleet composition is tabulated below:

Sr. No.	Type of Aircraft	Number of Aircraft
1.	TB-20	01
2.	Zlin-242L	02
3.	Diamond DA-40	13
4.	Diamond DA-42	02

Table 6: Aircraft Fleet Size

The FTO has in house maintenance setup as per CAR 145 which is approved by DGCA and was valid on the day of accident. The organizational chart of the flying club is shown in the figure below.

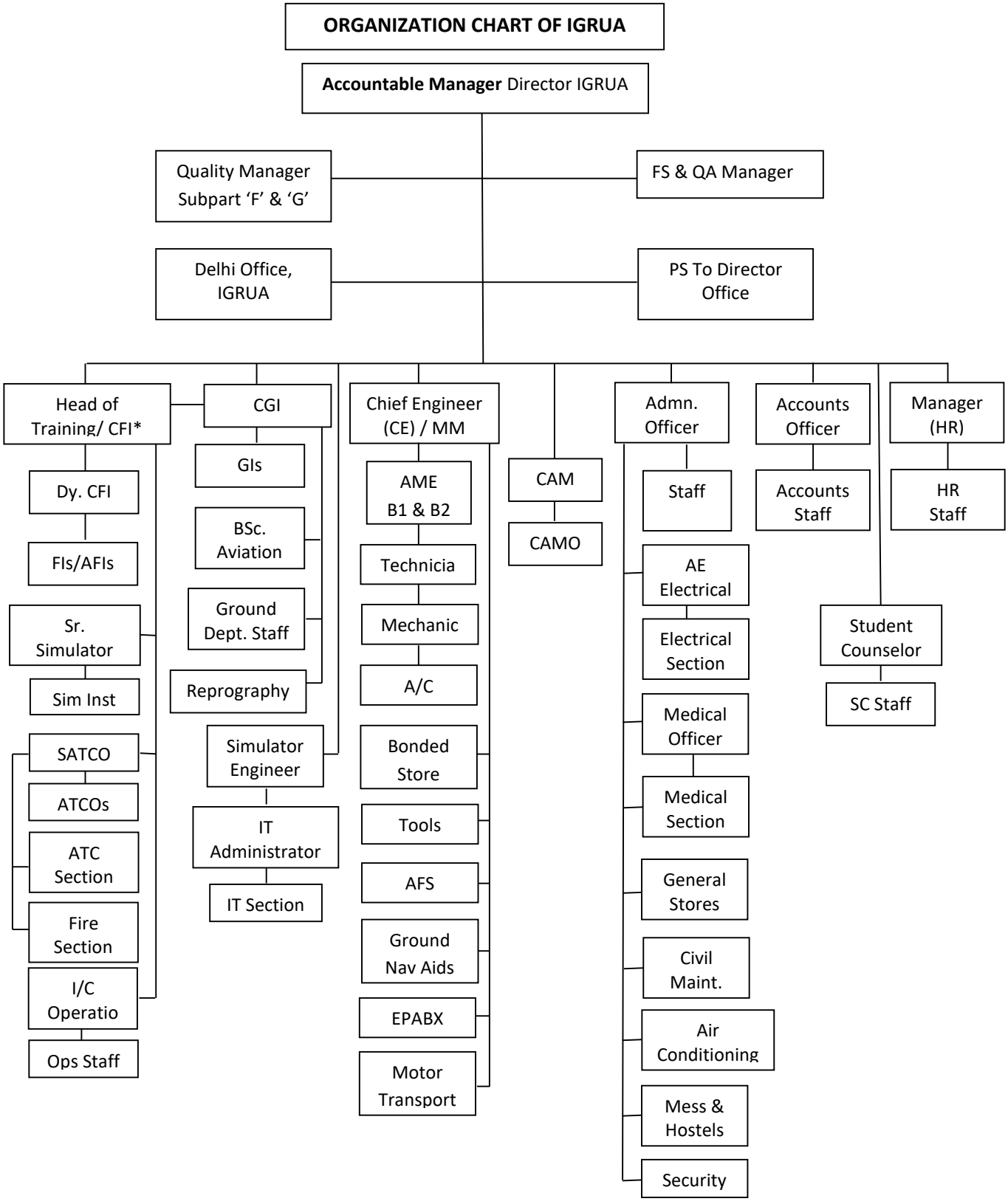


Figure 15: Organisation Chart

1.17.1.1 TPM (Training and Procedure Manual) of the Organisation

Company's Training and Procedure Manual Issue-03 Revision-0 after approval from DGCA was issued in May 2021. The TPM has contained the guidelines, procedures and requirements to be followed by trainees and Instructors for safe and efficient operation of the airplane as per the DGCA CAR, Section 7, Series 'D', Part- 1.

Emergencies

Engine Failures

TPM Appendix-14 has defined about the various 'Air Exercises' of training flight including Emergencies. The objective of this exercise is to provide knowledge on causes and consequences of the engine emergencies and to handle them properly during the flight. The relevant section of the Appendix is reproduced below:

Causes

- Fuel - This could be due to contamination (fuel quality), starvation (fuel is not getting to the engine from the tanks), exhaustion (there is no fuel left in the tank), or pump failure.
- Spark - The magneto system that provides the spark to the spark plugs may not be functioning correctly or at all.
- Air - Unusually an air intake blockage, due to a birds nest, bird strike, FOD etc.
- Mechanical - A total or partial failure of an engine component leading to loss of power. This includes the propeller.
- Another cause may be due to fire, and any one of them is usually associated with pilot mishandling, either during pre-flight checks or incorrect lever /control positioning.

Engine failure on Downwind:

Indication
Reduction in RPM & Dead silence in the cockpit.

Actions:
Put aircraft into glide & maintain best gliding speed
Choose a suitable landing site from 10 to 2 O'clock in the direction the flight.
Make sure all three levers (Throttle, Propeller & Mixture) fully forward
Fuel pump - ON
Fuel selector - change.
Ignition - Both
Alternate Air - Open.
If engine picks up, control with throttle, set course to base, make normal circuit and land.
If engine doesn't start working then secure the engine. Landing gears - UP (If applicable)
Thereafter give RT call (If time permits) with problem, position, and intentions then go for forced landing.

Faults:

- Not monitoring engine parameters.
- Not checking fuel selector position.
- Improper throttle and mixture lever position.
- Loosen quadrant friction lock.

Points of Airmanship:

- Never turn back to the runway (In case of failure during takeoff).
- Chosen landing site should not be populated, over residential area & large water bodies.
- Fly the aircraft as a priority.
- Use flaps as required.
- Avoid major obstacles.

Points of Engine handling:

- Smooth operation of throttle is mandatory.
- Monitor engine parameters.

Unquote

1.17.1.2 SMS Manual

Chapter 15 'Emergency Response Procedure (Fursatganj Airfield)'of SMS Manual has stipulated the procedures and guidelines on "Emergency Response Planning". The content of the said chapter which has relevance to this investigation is provided below:

Para 15.5- Off Base Accident/Incident

Initial information on aircraft accident/incident involving aircraft from IGRUA occurring outside airfield area may come either through ATC, Police Station or from local people or by other aircraft. The information needs to be verified through operations and ATC. ATC in turn will inform CI/CFI, CE, Operations, FS Manager, Director, CAO, HR and Security officer. On confirmation of accident/accident involving IGRUA aircraft following procedure is to be followed.

Para 15.5.1-Constitution of Crash Rescue Team

Following teams will assemble in front of FOC building within 00:45 minutes and move to the crash site at the earliest.

Fire Fighting Rescue Team detailed by Senior Aerodrome Officer (SAO)
Engineering staff detailed and co-ordinated by CE
Medical team detailed by AO
Additional manpower detailed by AO
Provision of vehicle by AO/MT to carry the personnel to the crash location
Security personnel for guarding the site by AO.

Para 15.5.2- Responsibility of ATC

Senior Aerodrome Officer (SAO) is to detail a crash tender and ambulance with requisite manpower. In case the IGRUA crash tender is unable to accompany the team, AO is to liaise with the nearest Fire Station for necessary help.

Para 15.5.4 -Responsibility of AO

AO is to detail additional manpower and security staff for guarding the crash site. He is to liaise with local police to provide security, control of local public and temporary accommodation required for the duration of stay. He is to liaise with nearest fire station for additional fire crash tender/fire tender, if required.

Para 15.5.5 -Responsibility of Flight Safety Manager

He is to ensure that the Mishap Response Kit is carried, co-ordinate the activity of Crash & Rescue Team, obtain & preserve the photographic evidence of the crash aircraft/site, and provide necessary co-ordination for the progress of the investigation by AAIB/DGCA.

Para 15.5.8 -Fire Fighting Rescue Team

The team would take expeditious action to move immediately along with the fire fighting vehicle(s) & ambulance to the site. On reaching the crash site take the standard Crash Crew Rescue Drill as per Appendix 'G' to this manual. Use of walkie-talkie is to be made to remain in communication with ATC for subsequent instruction.

1.17.1.3 Flying Orders

Flying Order Number 8.8, issued by IGRUA on 'Procedures for Flying Training,' has stipulated the procedures and guidelines to be followed during ab-initio phase. This order has clearly outlined the duties and responsibilities of the flying instructor. According to the Flying Order, upto the Fourth Solo training flight, the instructor of the trainee is entrusted with supervisory duty and has to monitor the student pilot's approach and landing. Further, the instructor has to offer guidance & advice as required by the trainee from taxi track link/ATC during these flights. Flying Order 8.8 is appended as Annexure 'E' to this report.

1.18 Additional Information

1.18.1 Checklists

Checklists to be followed by crew either during Normal operation or at the time of Emergency are contained in the Airplane Flight Manual.

The Chapter 4 'Normal Operating Procedures' has contained the checklist to be followed by flight crew during go-around procedure. The checklist is as follows:

GO-AROUND

1. Throttle……..MAX PWR
2. Airspeed…….67 KIAS (1200 kg. 2646 lb)
   66 KIAS (1150 kg. 2535 lb)
   60 KIAS (1000 kg. 2205 lb)
   54 KIAS (850 kg. 1874 lb)
3. Flaps…… T/O

Above a Safe Height:

4. RPM lever…… 2400 RPM
5. Airspeed ……76 KIAS (1200 kg, 2646 lb)
   73 KIAS (1150 kg, 2535 lb)
   68 KIAS (1000 kg, 2205 lb)
   60 KIAS (850 kg, 1874 lb)
6. Flaps……UP
7. Electrical fuel pump …… OFF

In Chapter 3 'Emergency procedures' checklist pertaining to 'EMERGENCY LANDING WITH ENGINE OFF' and 'Loss of RPM' are provided. Both checklists which are required to be followed by flight crew in case of emergency are as follows:

ENGINE PROBLEMS

3.2.3 ENGINE PROBLEMS IN FLIGHT

(g) Loss of RPM

Electrical fuel pump…….. check ON

Fuel tank selector …….. check

Friction adjuster for throttle quadrant…… check sufficiently tight

RPM lever……. HIGH RPM

- Listen for rise in RPM

If there is no audible rise in RPM, it is probable that the governor system is defective. In this case the RPM can be regulated within certain limits using the throttle.

Land at the nearest appropriate airfield.

Be prepared for possible emergency landing.

If the indication does not change in spite of an audible rise in RPM, it is probable that the RPM indication is defective, which should thus be ignored (the airplane should be serviced).

3.5 EMERGENCY LANDINGS

3.5.1 EMERGENCY LANDING WITH ENGINE OFF

1. Select suitable landing area. If no level landing area is available, a landing on an upward slope should be sought.
2. Consider wind.
3. Approach: If possible, fly along a short-cut rectangular circuit. On the downwind leg of the circuit the landing area should be inspected for obstacles from a suitable height. The degree of offset at each part of the circuit will allow the wind speed and direction to be assessed.
4. Airspeed…….. 76 KJAS (1200 kg, 2646 lb)
   73 KJAS (1150 kg, 2535 lb)
   68 KIAS (1000 kg, 2205 lb)
   60 KIAS (850 kg, 1874 lb)
5. If time allows……. advise ATC
6. Fuel tank selector……OFF

When It Is Certain That the Landing Field Will Be Reached:

7. Flaps…….. LDG

8. Safety harnesses ……tighten

CAUTION

If sufficient time is remaining, the risk of fire in the event of a collision with obstacles can be reduced as follows:

- Ignition switch ……. OFF
- Master switch (ALT/BAT) …….. OFF

9. Touchdown…… with the lowest possible airspeed

1.18.2 SD Card Data

The Garmin G1000 has the capability to record flight data parameters to a removable SD card if the G1000 has the proper system software. This feature will automatically record a wide range of flight and engine parameters and offer the ability to perform post-flight analysis. The flight data is saved to the top SD card in the MFD automatically. A flight data file is saved as a separate file for each flight onto the SD card and is created every time the MFD power is cycled to separate the flight data. Data Cards with at least 2 Gigabytes (GB) capacity are to be installed in the upper MFD slot for all flights.

The data retrieved from the SD card was initially shared with the OEM on 14th October 2022 so that serviceability of engine could be ascertained based on analysis of raw data. After analyzing the data, on 21st June 2023, OEM has concluded that “RPM was steady at around 1K RPM or less showing glide type flight with a reduction in fuel flows for the RPM and decent type flight”.

The data was further examined by the investigation team to establish relation between different parameters. Based on the parameters retrieved from the unit, following graphs were plotted for analysis of engine performance.

Altitude

1. Aircraft started descending approximately from 1514 feet
2. Go-around was initiated (at approximately 516 feet)
3. After climbing, aircraft joined the circuit altitude
4. During level flight, erratic variation observed in flight altitude than preceding flight
5. Aircraft hit the ground (approximately at 370 feet altitude)

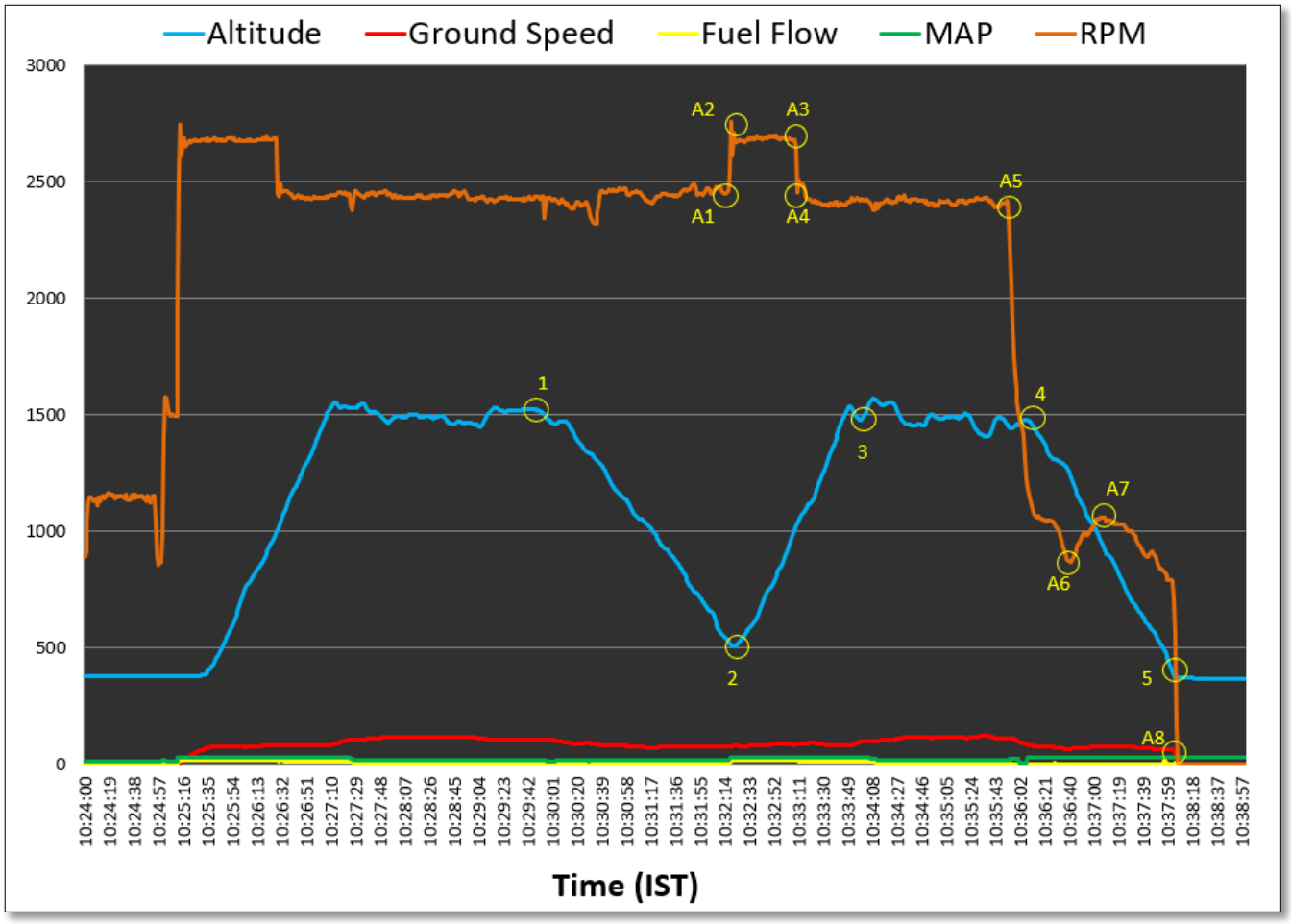


Figure 16: Graph 1 (Flight Time versus other parameters)

Engine RPM

A1. Engine rpm started increasing.
A2. Engine rpm reached maximum i.e 2700 rpm
A3. Maintained upto 2700 rpm during climb phase
A4. RPM deduced to normal i.e 2400 rpm after reaching circuit altitude
A5. Engine rpm started dropping
A6. After sudden drop, engine rpm reached upto 870 rpm
A7. A slight increase in engine rpm was observed and it reached upto 1030 rpm
A8. Continuous drop in engine rpm was observed till the aircraft collided with ground

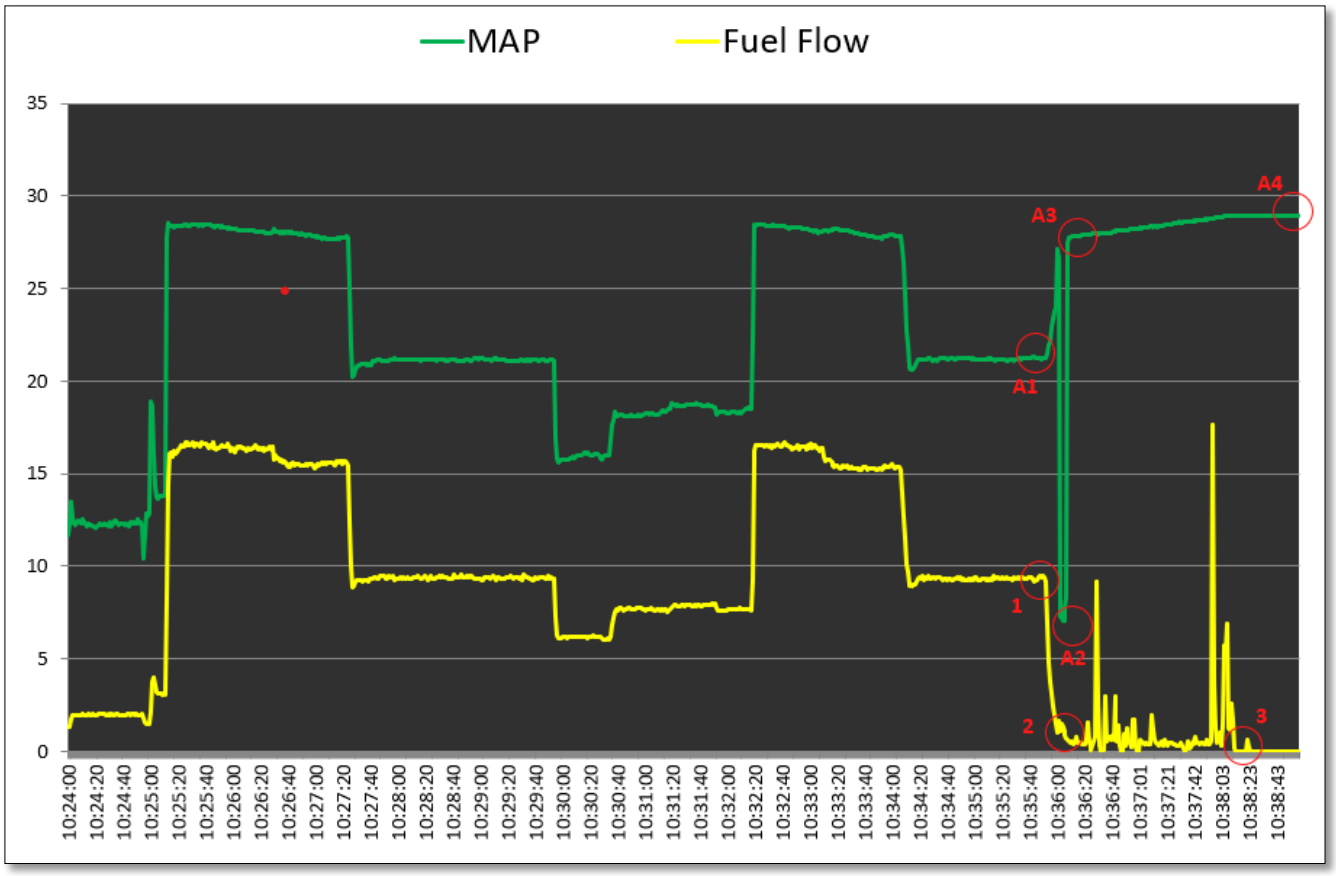


Figure 17: Graph 2 (Flight Time versus Fuel Flow & MAP)

1. Fuel flow suddenly dropped from 9 gal/hr to 1 gal/ hr.
2. Between point 2 and 3, Fuel flow was not uniform and two peaks were also observed

A1. MAP initially increased from 21 psi and reached upto 26 psi
A2. Suddenly dropped from 26 psi to 7 psi
A3. MAP again reached upto 27 psi and remained constant thereafter till the aircraft collided with trees. MAP did not varied as per the fuel flow readings.

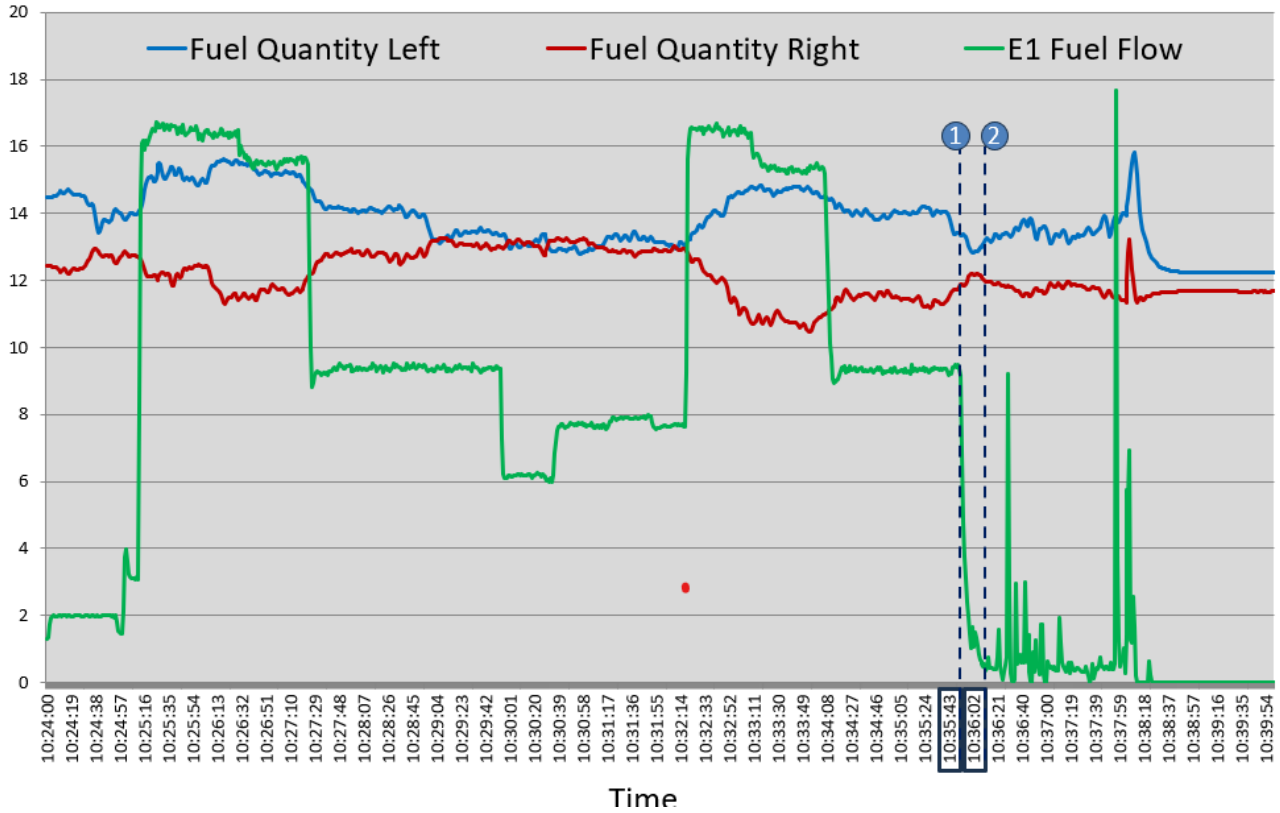


Figure 18: Graph 3 (Flight Time versus Fuel Parameters)

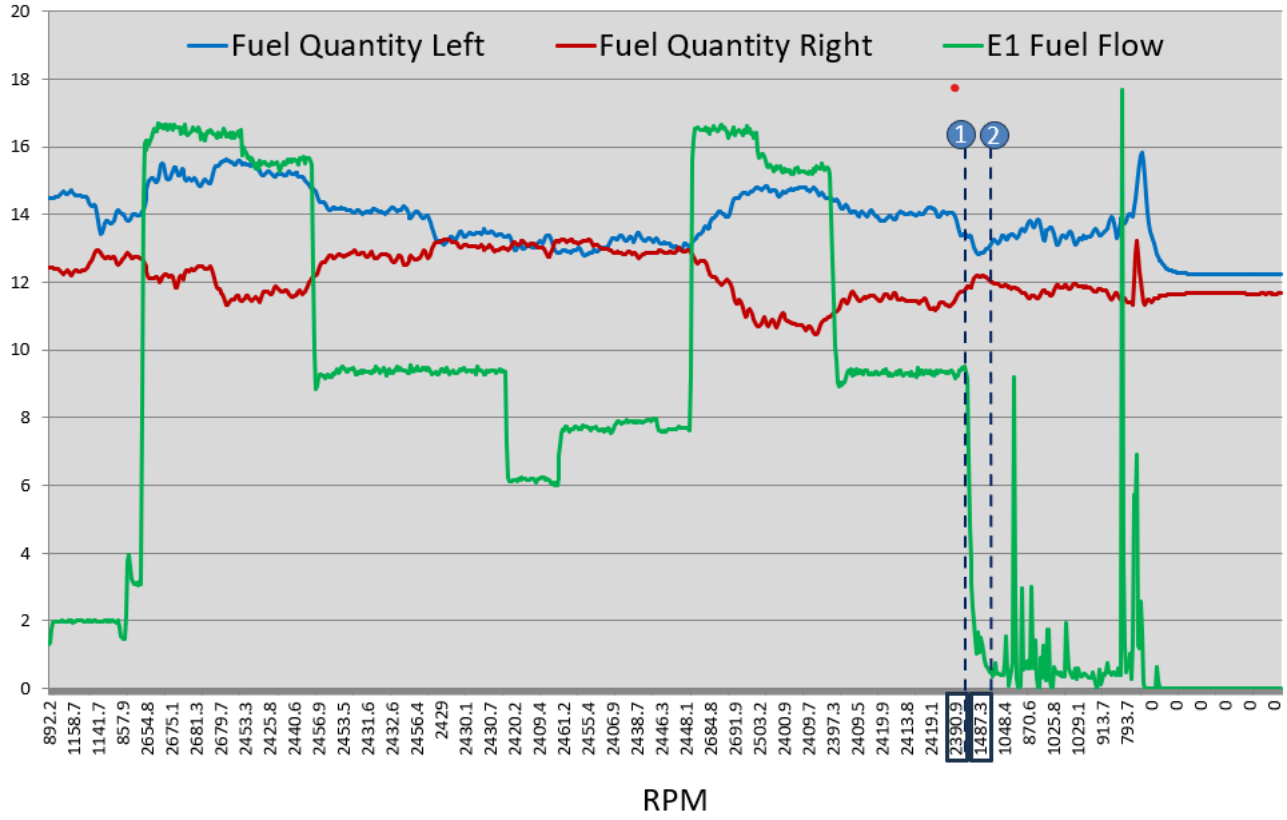


Figure 19: Graph 4 (RPM versus Fuel parameters)

1. Engine rpm was around 2390 at 10:35:43 IST when the fuel flow was approx. 9 gal/hr.
2. Engine rpm reached 1487 at 10:36:02 IST while the fuel flow also decreased upto 1 gal/hr.

Further, with the help of SD card data, flight path of the final circuit leg from initiation of go-around till the forced landing of the aircraft, projected on google map (Refer Fig No. 9).

1.18.3 Engine Strip Examination

To ascertain about the serviceability of the engine and its components, the involved engine was sent for strip examination at a DGCA approved organization. The engine arrived at their facility on 24 April 2023. Thereafter, the engine was inducted for strip examination and the examination was carried out in presence of AAIB team.

The **e**xternal condition of the box along with internal mountings of the engine were assessed in the presence of investigation team and they were found satisfactory.

The engine strip examination report along with the photographs is included in this report as Annexure 'A' to this report. The inference drawn from the teardown examination is as follows:

Inference of Engine Strip Examination:

All the internal parts of the engine observed during strip examination were found in good condition. Bench check of the electrical accessories showed satisfactory results. The damages observed on the engine would be secondary damages due to impact.

1.19 Useful or effective Investigation Techniques

Nil

2. ANALYSIS

2.1 Serviceability of Aircraft

Scrutiny of Aircraft and Engine Log book revealed that as on 13 June 2022, both aircraft and its engine had completed 10057:24 hrs (TSN) and 8057 hrs (TSN) respectively. The last Scheduled inspection 2000hrs/12 years was carried out on 16.05.2022. Thereafter, aircraft had flown 87:07hrs, before it met with an accident on 13 June 2022.

Scrutiny of the aircraft records revealed 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 Fuel System:

The operational check of electric fuel pump and inspection of fuel carrying lines till the fuel manifold did not reveal any abnormality in the system, hence, it was capable of generating positive feed during emergency.

Analysis of SD Card data:

The analysis of data retrieved from the SD Card established that the engine RPM dropped during the training flight in spite the throttle lever, RPM lever and mixture lever were selected to fully forward position (Maximum RPM Condition) as stated by student pilot.

Engine Strip Examination:

The strip examination of the engine revealed that throttle lever and fuel mixture shaft of the fuel injector did not exhibit the normal functioning because lever got stuck at a fixed position whereas shaft was broken. In addition to this, the engine driven fuel pump was also found broken.

The strip examination concluded that damages observed on the engine and its components were consequential to collision with trees as well as heavy impact with ground.

As the engine experienced a high impact load resulting into its component failures, therefore, further testing of these components/parts could not be carried out to establish their serviceability.

Therefore, it could not be confirmed why the engine RPM dropped even after all three levers were set to fully forward position (Maximum power setting condition) at the time of engine failure and failure of which specific component led to this situation.

2.2 Weather

The weather recorded at Fursatganj airfield was above minima with visibility of 5000 meters and winds favorable to carry out the training flying.

The local atmospheric conditions i.e the ambient temperature and the Dew point temperature, were not supportive of icing in the fuel system, which could result in the formation of ice in the fuel system and subsequently lead to a drop in engine RPM.

From the above, it can be concluded that weather had no bearing on this accident.

2.3 SD Card Data Analysis

Based on the data retrieved from the SD card, few graphs containing different parameters have been plotted to examine the engine performance (Refer **1.18.2-SD Card Data**). Based on the analysis, following salient facts are drawn from the graphs:

1. During final leg, go around was initiated at 0502 UTC while the aircraft was at 516 feet AMSL.
2. After go-around, the aircraft again attained an altitude of approximately 1508 feet at 0503 UTC.
3. After joining the circuit altitude, aircraft's engine was producing sufficient power while rotating at approximately 2400 rpm till 0506 UTC. (Corroboration of graph data confirmed the statement of Student pilot that nearly at the same time he had communicated to ATC about "Experiencing Engine Failure").
4. After 0506 UTC, engine rpm started decreasing and within 40 seconds it reached upto 870 rpm.
5. At the same time the fuel flow was also decreasing. The fuel flow which was at 9.15 gal/hr at 10:35:52 IST suddenly dropped to 0.85 gal/hr at 10:36:06 IST. During same time MAP also dropped from 21 psi to 7 psi. However, MAP increased to 27 psi at 10:36:16 IST and it remained almost constant till the collision of aircraft with the tress.
6. After 10:36:00 IST, the MAP reading was not in line with fuel flow.
7. The fuel flow abruptly changed once it reached 0.85 gal/hr. The fuel flow reading reached upto 17.67 gal/ hr at 10:37:56 IST.
8. At 10:37:59 IST, the aircraft altitude reached 380 feet and ground speed reduced to zero. The elevation of crash site was found 370 feet approximately. This indicates that at this point the aircraft impacted the ground and came to final rest position.

2.4 Crew Aspect

The Student Pilot issued with an SPL was meeting all the prerequisite requirements including medical to operate his 3rd solo sortie. Prior to the accident flight, Student Pilot had a total flying experience of 28:05 hrs including 00:40 hrs as PIC on type.

As per FTPR records, Student pilot performance during the pre-solo checks was not satisfactory. Therefore, before releasing the student pilot for his first Solo flight, corrective sorties were suggested by Flying Instructors to enhance the flying skills. After undergoing corrective sorties and successful demonstration of flying skills, trainee was released for first solo flight.

During the 3rd Solo sortie, while the aircraft was approaching for landing, another aircraft had already lined up on runway 27 for takeoff, therefore, the ATC instructed the trainee to initiate a go around. The student pilot followed the go-around procedures and subsequently joined the circuit. No abnormality was noticed in the cockpit till the aircraft reached end of downwind leg.

While the aircraft was about to join the base leg, the student pilot observed a drop in engine RPM. Subsequently, the student pilot followed standard operating procedures (SOP) to regain the engine RPM, but it continued to drop. At this point, the student pilot decided to carry out a forced landing, and relevant checklists were followed accordingly.

While the aircraft was heading towards the open field, the student pilot observed few trees in its approach path. Subsequently, the Fuel pump was turned off, the throttle & fuel mixture were put to idle, and a right aileron correction was given to avoid the trees. However, the aircraft collided in the mid of the patch even though obstacle free paths were available on both sides of the trees.

The SD Card data revealed that aircraft came to rest at 0508 UTC; however, the last data captured by the Garmin unit was of 0545 UTC indicating that student pilot left the aircraft before disconnecting the aircraft's battery supply.

Although the student pilot followed the SOP during the flight, the SD card data has revealed that after the accident, the student pilot left the aircraft without switching off the power supply. Therefore, the student pilot did not adhere to the procedures outlined in the 'Emergency Landings' checklist.

2.5 Organisation Aspect

2.5.1 Duties and Responsibility of Post Holders

The duties and responsibilities of different post holders to respond in emergency situations have been stipulated in the company document i.e ERP which is the part of their SMS Manual.

As per company ERP, the role & responsibilities of SAO employed with the organization is to ensure that crash tender be detailed to crash site and must be the part of crash rescue team. However, the Fire Station Log register has revealed that no CFT vehicle was deputed to crash site on the day of accident.

On the day of accident, the Flight Instructor who was entrusted with the responsibility of supervision of training flight of student pilot left the ATC tower in the middle of the training flight and therefore was not available on RT to guide the student pilot once he encountered emergency situation. Therefore, Flight Instructor did not adhere to the guidelines and procedures stipulated in the Flying Orders issued by IGRUA.

Above mentioned shortfalls established that the aforesaid post holders' of the organization did not adhere to the guidelines stipulated in company SMS Manual, Flying Orders or TPM.

2.6 Circumstances leading to the Accident

During the third circuit and landing exercise, while the aircraft was on final approach, the ATC instructed the student pilot to initiate a go-around as another aircraft of the organization had already lined up on runway for takeoff. Thereafter, the Student pilot followed the go around procedures and subsequently joined the circuit altitude.

When the aircraft was at the end of the downwind leg, Student pilot observed slight variation in engine sound and subsequently noticed drop in engine rpm. Thereafter, the Student pilot followed the SOP and all the three control levers were put to maximum forward position (i.e Throttle, RPM and Fuel mixture)-condition required for generating maximum engine power. Simultaneously alternate air was also selected. But the engine did not respond to the control inputs made in accordance to 'Engine failure' checklist to revive the engine power. Thereafter, the 'Emergency Landing' Checklist was followed and as per the checklist an open field was selected to carry out the forced landing.

While the aircraft was approaching forced landing site, as per the procedures laid down in "Emergency Landing with Engine Off" checklist, the student pilot selected the fuel tank selector to 'OFF' position. Thereafter, before the trees could have been avoided, the aircraft had collided with them. It appears that student pilot misjudged the approach path of the aircraft and finally failed to initiate timely corrective actions to avoid the patch of trees. This resulted into collision of aircraft with the trees and subsequently, the uncontrolled aircraft hit the ground before it stopped at final rest position.

3. CONCLUSION

3.1 Findings

Aircraft:

3.1.1 The Certificate of Airworthiness, Certificate of Registration and Airworthiness Review Certificate of the aircraft were valid on the day of accident.

3.1.2 No inspection schedule was due on the aircraft & its engine as on date of accident.

3.1.3 Scrutiny of the aircraft records revealed that, there was no snag pending on the aircraft prior to the accident flight.

3.1.4 Aircraft records showed compliance with all applicable Airworthiness Directives (ADs), Service Bulletins (SBs), and mandatory modifications.

3.1.5 Aircraft was equipped with ELT (Emergency Locator Transmitter) but did not activate during this accident.

Engine:

3.1.6 All the components of the electrical system (fitted on the engine) during bench check were found serviceable.

3.1.7 The electrical fuel pump and fuel carrying lines up to fuel manifold, were examined post-accident and found serviceable.

3.1.8 The engine driven fuel pump dislodged from its installation point and found damaged.

3.1.9 The strip examination of the engine revealed that mixture shaft was broken and throttle lever also got stuck at a single position.

3.1.10 Analysis of the SD card data from the Garmin unit revealed a continuous drop in engine RPM despite throttle, RPM lever, and mixture lever being set to the maximum power condition.

Weather:

3.1.11 The local weather was conducive for training flight and prevalent ambient and dew point temperatures were not supportive for icing in the fuel system which could have led to the engine failure.

Student Pilot:

3.1.12 The student pilot, holding a Student Pilot License (SPL), met all prerequisites, including medical requirements, to operate the solo training flight.

3.1.13 Before leaving the aircraft, the battery was left in the 'ON' position. It was switched 'OFF' only after approximately 36 minutes after the accident.

Organization:

3.1.14 The Flying Instructor did not adhere to the procedures outlined in Flying Orders issued by IGRUA and left the ATC tower while the solo training flying was in progress. As he was not available in ATC tower therefore, could not guide the student pilot once he communicated about engine failure on RT.

3.1.15 Company post holders did not adhere to the guidelines and procedures laid down in Emergency Response Plan and therefore, no Crash Fire Tender (CFT) vehicle was dispatched to the site post-accident.

3.2 Probable cause of the accident

The accident occurred when the aircraft engine lost power in flight and failed to restart despite a few attempts by the Student Pilot. Thereafter, SOP was followed, and while approaching for an emergency landing, the student pilot could not glide the aircraft properly and the aircraft collided with trees. The investigation has established that an engine component failed, but conclusive evidence to establish the serviceability of components was lost due to damage to engine components.

Contributory Factor(s):

1. Lack of supervision by Flight Instructor

4. SAFETY RECOMMENDATIONS

4.1 It is recommended that DGCA may issue instruction to all FTOs, making it mandatory for ARFF to dispatch their CFT to crash site along with the Crash Rescue Team without fail.

4.2 It is recommended that IGRUA ensures that Instructors entrusted with supervisory duties during solo flights adhere to company regulations and are always available on RT to guide student pilots.

4.3 IGRUA shall emphasize to its student pilots the importance of adhering to checklists and SOPs.

4.4 Installation of onboard audio/video recording device in the cockpit of trainer aircrafts needs to be implemented to enhance oversight of Flying Training Organization and to facilitate

instructors in analyzing the performance of the trainee pilots post solo flights. This tool will also assist in investigations by DGCA and AAIB.

Date: 20 March 2024
Place: New Delhi

Annexure 'A'

ENGINE TEARDOWN REPORT

A. GENERAL EXTERNAL INSPECTION

a) EXTERNAL CONDITION OF THE ENGINE

Engine external condition was checked. Following observations made.

1. All the accessories were found at their mounting locations.
2. Starter, though in its place on engine the top portion found broken (Photograph-2).
3. The Fuel Injector Throttle could not be moved. (Photograph-3).
4. Fuel pump found broken. (Photograph-4).
5. Rotation of the crankshaft in as received condition found satisfactory.
6. Dent noticed on No.2-cylinder induction tube. (Photograph-5)

B. STRIPING OF THEENGINE

The engine was progressively stripped. The observation made are given below:

a) Condition of the connecting rods of all 04 cylinders found satisfactory.

b) The piston pin of all the cylinders found satisfactory.

c) Condition of the piston of all the cylinders found satisfactory.

d) Condition of the piston Pins of all the cylinders found satisfactory.

e) The internal condition of the Cylinders found satisfactory.

f) Condition of the Cam shaft found satisfactory.

g) Condition of the Crank shaft found satisfactory. No evidence of dry run at bearing locations.

h) Condition of connecting rods with the bearing was satisfactory.

i) Inside surfaces of all the casings found in good condition.

j) Normal oil level was found in oil sump.

C. ELECTRICAL COMPONENTS

a) Spark plugs: Qty. 08 Spark plugs received. The external condition of all the 08 plugs found in good condition. Bench check of the plugs in as received condition found meeting the requirement.

b) Magnetos: Qty. 02 received. External condition & Rotation of both the units in as received condition satisfactory. Bench check carried out & function found meeting the requirement.

D. FUEL COMPONENTS

a) Flow divider external condition was good and checked for flow of fuel on a rig found satisfactory.

b) All fuel lines conditions were found satisfactory.

c) Fuel pump dislodged form its mounting location and broken. Fuel pump disassembled in detail no abnormalities was noticed. (Photograph-6).

d) Fuel Injector throttle lever could not be moved. Injector mixture shaft was found broken. (Photograph-7).

E. STARTER/ALTERNATOR:

a) The starter found broken due to impact.

b) No damage observed on Alternator.

F. MECHANICAL COMPONENTS INSPECTION (STRIP EXAMINATION)

a) Visual Inspection of Pistons

1. Carbon deposits on dome of piston was found normal.
2. Piston rings of all the pistons were found with free movement.
3. Piston pins were found satisfactory.

b) Visual/Dimensional Inspection of crankshaft and connecting rod bearings

1. Crankshaft and connecting rod bearing was inspected after disassembly.
2. Crankshaft flange run out, dimension of all bearing journal measured found within the limit.
3. No abnormal wear out or scuffing of bearing was found.
4. Connecting rod squareness & parallelism check carried out found satisfactory.

c) Cylinders

1. No damages noticed on cylinders.
2. No abnormalities noticed on cylinder barrels.

d) Oil filter:

1. The oil filter was cut opened and no metal particle was found (Photograph-8).

e) Crank Case & Oil Sump

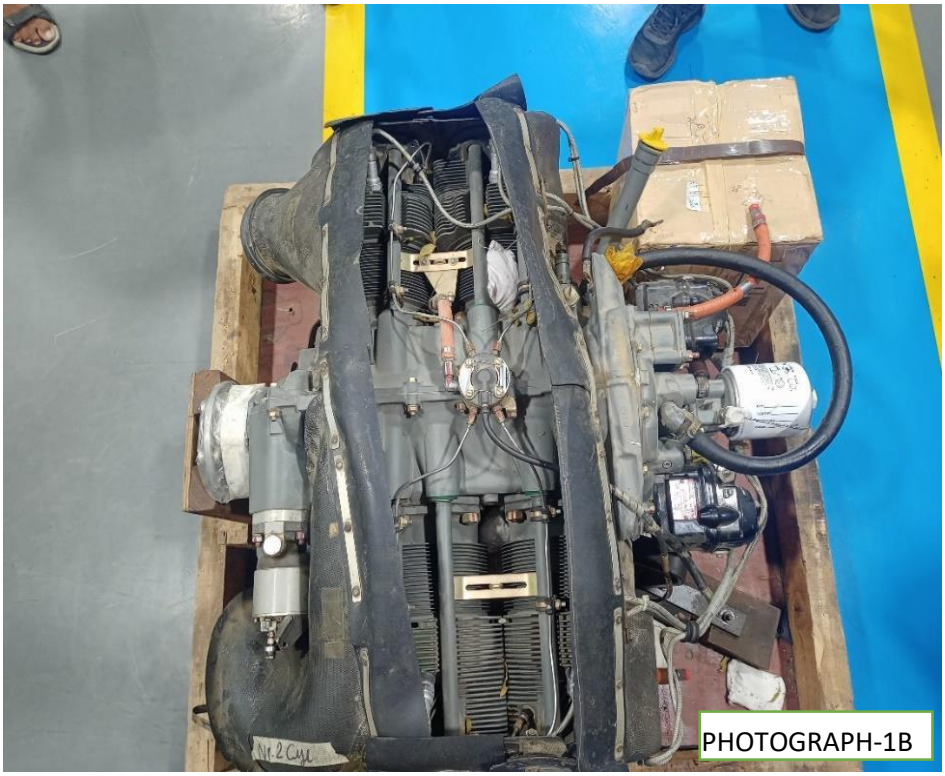
1. No internal damages noticed on these casings.

G. FINDINGS:

There is no damage observed on the internal parts of the engine. The external damages observed on parts and accessories were due to impact of the engine. The Carbon deposits noticed on the piston dome is a normal as observed on engines received for overhaul. The Stuck fuel injector throttle lever and fuel injector mixture shaft broken could be due to impact.

PHOTOGRAPHS

PHOTOGRAPH-1A



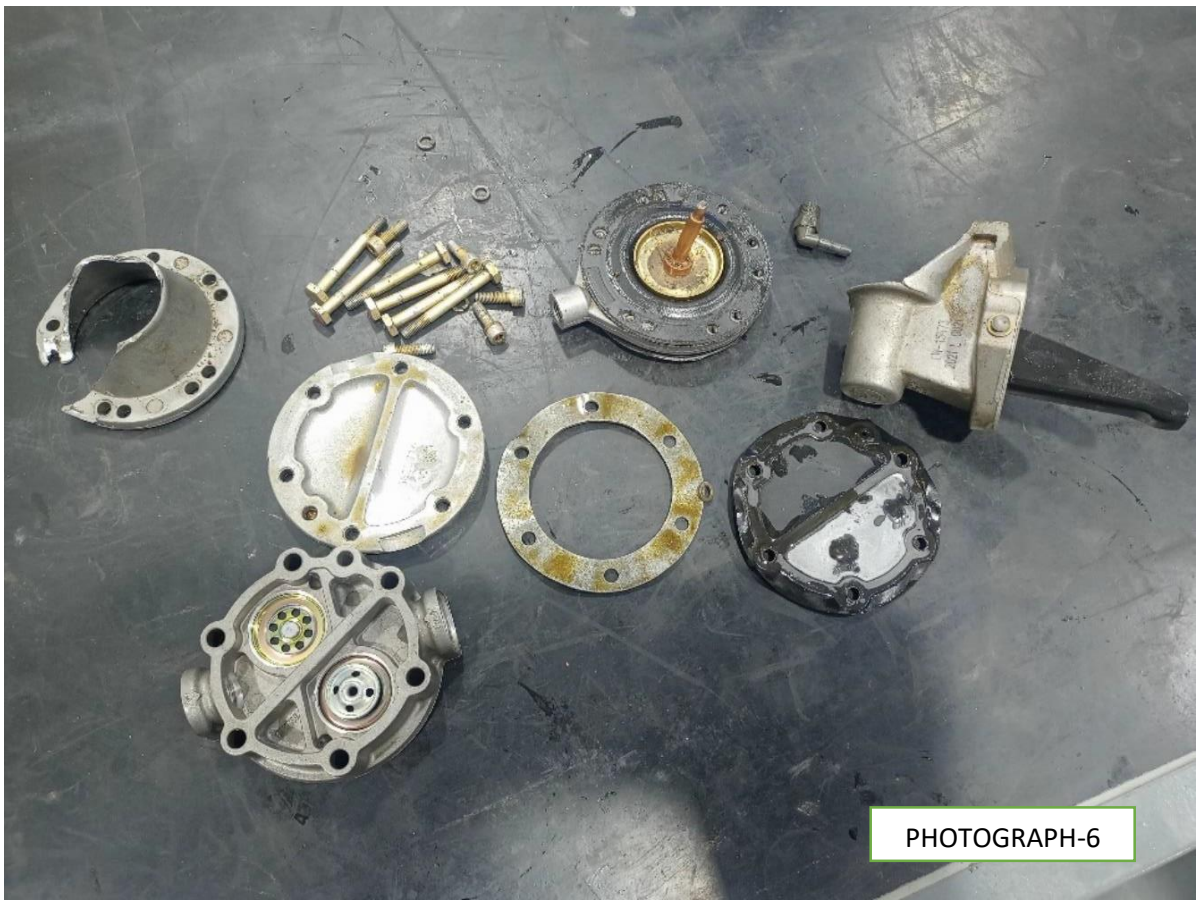
PHOTOGRAPH-1B

PHOTOGRAPH-2

PHOTOGRAPH-3

PHOTOGRAPH-4

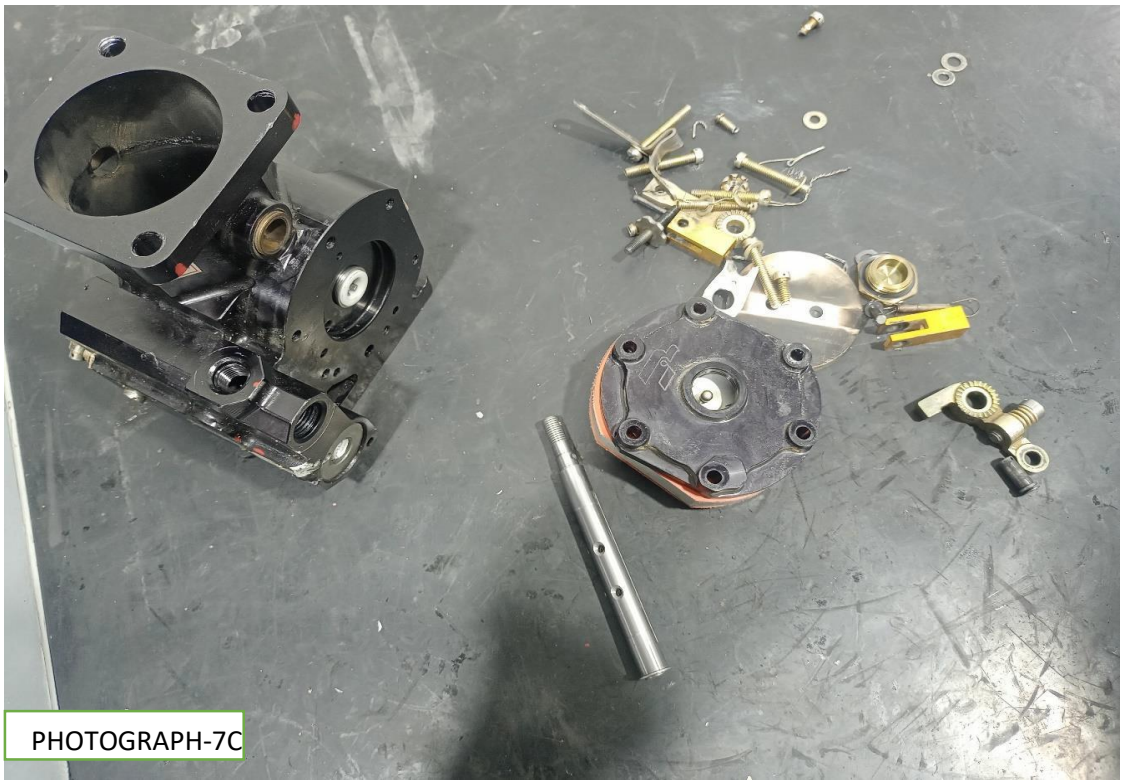
PHOTOGRAPH-5



PHOTOGRAPH-6

PHOTOGRAPH-7A

PHOTOGRAPH-7B



PHOTOGRAPH-7C

PHOTOGRAPH-8

Annexure 'B'

CRASH CREW RESCUE DRILL

1. On ATC activation by alarm bell or intercom, crash crew leader to blow whistle & get all personnel to mount crash tender & ambulance.
2. Ensure carriage of cutting and lifting tools in crash tender.
3. The gypsy to go to the Hanger No.2 & collect towing arm, jack, spare wheel etc and engineer on duty with other personnel & move to site with walky talky as per ATC instructions.
4. All rescue vehicles to use taxiway after ATC permission & entry / crossing to runway will be only after ATC permission through walky-talky.
5. **Crash tender to be followed by ambulance with medical crew.**
6. Crash crew leader to establish wind direction so that parking at crash site is with aircraft kept downwind. Wind must assist the throw of water/foam.
7. At crash site look for pilots outside the aircraft. Medical crew to attend.
8. If pilots are trapped inside aircraft crash crew leader to direct crew to bring fire under control and assist in rescuing the crew to vacate the cockpit.
9. If cockpit is jammed crash crew is to break the Perspex by axe & if pilots are trapped in inverted position crew to activate motorized cutter. Watch for fuel overflows & use foam.
10. Time permitting crash crew to check fuel, ignition & battery master switches **'OFF'**& help pilots out. Medical crew to standby with stretcher & use if required.

Annexure 'C'

CIRCUIT PATTERN

Objective:

- To takeoff and follow standard procedures that conforms to the aerodrome traffic circuit, avoiding conflict with other aircraft.
- To carry out an approach and landing using the most suitable runway.

Essential Knowledge:

- Knowing that all aircraft should be following these standard procedures makes it easier to identify which runway should be used, where other aircraft are (or can be expected to be), (and who has the right of way (or priority) in the sequence to takeoff or land.
- The circuit pattern flown at Fursatganj is left hand pattern for both the runways which means that all turns are made to the left.
- The circuit can be divided into two sides namely the 'live side' and the 'dead side'. The 'live side' is that side where aircraft flying in sequence along the downwind leg to the final approach for landing.
- Aircraft joining the circuit from above the airfield will descend only on the ' dead side' before fitting themselves into the pattern.

Air Exercise:

Upwind Leg:

The upwind leg requires you to maintain the runway heading(winds corrections as required) and carry out after takeoff checks before you turn onto the crosswind leg (700ft AGL).

Crosswind Leg:

The climbing turn from the initial climb onto the crosswind leg is usually started at 700 ft AGL. The turn is carried out with 10° angle of bank and climb speed. The aircraft is leveled out at the circuit height of 1000 ft AGL and the throttle reduced to maintain the cruise speed. The direction to roll out on the crosswind is such that you fly on a direction that is opposite to the direction of the runway you took off from. Having attained the correct lateral displacement from the runway a roll out is carried out onto downwind.

Downwind Leg:

The purpose of the downwind leg is to provide the pilot an opportunity to prepare for landing. It is here that the aircraft configuration, position, height and speed are set ready to begin the final approach to land. It is vital to fly the downwind leg with the aircraft in the correct position in relation to the runway and get ready to execute a turn onto the base leg. The correct lateral spacing at the

correct height is confirmed, when the wings are level, by visually checking that the runway appears at correct displacement. Carry out Approach Checks.

The heading will need to be adjusted, to overcome the effect of wind at circuit height, to be able to track parallel to the runway. Even if at ground level the wind is straight down the runway, at circuit height there may be a crosswind on the downwind leg. Look ahead along the track to select ground features to aid tracking. Commence a turn onto the base leg when runway is 45° (Approx 7 to 8 o'clock).

Base Leg:

The base leg is flown 90° to the runway heading and requires you to perform the Landing Checks as soon as you roll out on the base leg. Pick up a ground feature to assist in rolling out. Adequate offset is to be given so as to cater for the winds and fly the desired path along the ground.

Final Turn:

At the end of the base leg, a descending turn onto final is commenced so as to roll out along the final approach heading. An appropriate angle of bank not exceeding 20°, adjusted for the wind conditions, must be used in the turn to achieve this position. Trim is maintained throughout this turn and it is vital to monitor both the speed and attitude during the turn to avoid any chance of stalling inadvertently. An accurately flown finals turn will place the aircraft at the ideal point from where the final approach is started.

Final Approach

The final approach down to the landing should follow a safe path at a constant, acceptable angle of descent. A final approach starting from correct positioning over the top finals will give an acceptable angle and a safe approach, if this angle is maintained down to touchdown. The apparent shape of the runway as seen from the top of finals can be used to assess whether the approach is correct and at an acceptable descent angle.

- At 300' AGL, after checking that the aircraft is in the landing configuration a callout must be given saying,
- "Approach Stabilized, Going for Landing".
- And if, by any chance your aircraft is not stabilized before 300'AGL, you must open full power and Go Around. (Trainee must be taught and demonstrated the go around procedure in the initial circuit and landing stage).

Faults:

- Do the checks and procedures thoroughly at all points in a circuit.
- Keep an eye on your displacement from the runway.
- Monitor the RT and the traffic properly.
- Maintain the correct speeds in all the legs of the circuit.

- Identify the correct ground feature.

Points of Airmanship:

- Always keep a sharp look out for other aircraft and birds. Knowledge of the circuit traffic through visual observation and listening out on RT is vital. Give the correct RT calls at the designated point on circuit.
- After acknowledging the landing sequence (on downwind) ensure that all aircraft ahead of you are in visual contact. If not so, ask the ATC for their position. Do not commence the approach if the aircraft ahead of you is not in visual contact.
- Initially fly circuits with the help of ground features.
- Spacing is to be carried out only on the take-off leg. Listen out for the RT call of the aircraft ahead for proper spacing. Do not attempt to space out at the end of the downwind leg. If close to the aircraft in front at this stage, maintain height, go round/carry out another circuit.

Points of Engine Handling:

- Monitor engine Parameters at specified places.
- Always ensure that the throttle operation is smooth.
- Do not pull back on the throttle after round off, as this may result in low idling RPM and may be an engine cut.

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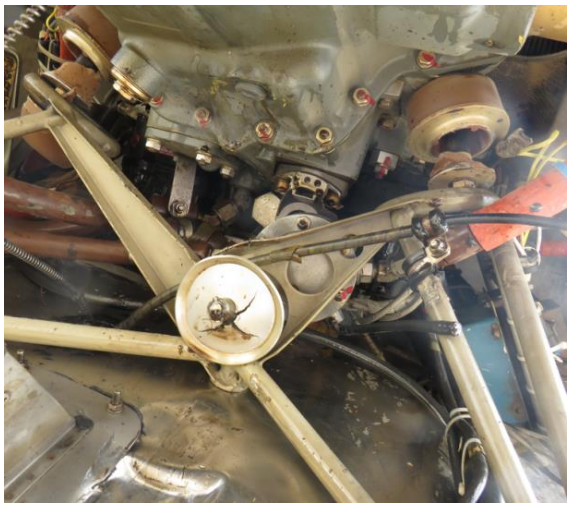
Annexure 'D'

DAMAGE TO AIRCRAFT

1. The left wing was fully damaged from Approx 5.1 ft from fuselage

2. Right wing aileron mass balance found damaged

3. Nose landing gear strut found broken from approx 21cm from forward

4. Nose landing gear elastomeric pack found broken and all rubber segments detached from elastomeric pack

5. Cylinder No 2 baffle found fractured

6. Exhaust stack found bent Exhaust muffler found compressed and damaged

7. Induction air filter box found damaged

8. Cut marks found on RH main wheel tyre

9. Intake pipe of Cylinder no 2 & 3 are found damaged and dented.

10. Starter solenoid found separated from starter

11. Engine cowling damaged

12. No 1 Propeller blade found bent from approx. 33 cm from tip.

13. No 2 Propeller blade found slightly twisted from root to tip

14. Rudder bracket found damaged towards right side

15. Dorsal fin found cracked at 2 places

16. Ventral fin found damaged

17. DME antenna found broken

Other Damages

Few branches of neem tree and bamboo found broken

FLYING ORDER NUMBER -8.8
PROCEDURES FOR FLYING TRAINING

1. **First Solo:**

   a) The trainee should have undergone progress checks and be declared fit to continue flying training at 5 hours and 10 hours of flying training in the ab-initio phase. During the solo check the trainee is required to demonstrate the ability to land the aircraft safely. The trainee must demonstrate the ability to act safely in case of emergencies like engine failure during T/O, after T/O and on circuit.

   b) The instructor of the trainee must monitor the solo trainee's approach and landing and offer guidance as required from taxi track link/ ATC as applicable for the runway in use.

2. **Second Solo (Two circuits and full stop landings):**

   a) The trainee must demonstrate the ability to land the aircraft safely and analyze errors during the previous Cct app& ldg. so as to improve the subsequent Cct& ldg.

   b) The instructor of the trainee must monitor the first full stop landing by the trainee and if in his opinion the trainee can continue for the second Cct& ldg. he/ she may order the trainee to carry out the second cct and and landing. In case the app& ldg is not of the required standard the trainee is to be recalled to the disposal after the first landing and debriefed. The trainee may be taken up for another check sortie as deemed fit by the instructor.

3. **Third Solo(Three circuits and full stop landings):**

   a) The trainee must demonstrate the consistency and ability to land the aircraft safely despite adverse circumstances. The trainee must demonstrate a higher ability to analyze and improve upon errors in C& L and a greater degree of consistency.

   b) The instructor of the trainee must monitor the first landing and give guidance and advice as required for the trainee to continue for two more ccts and landings or return to dispersal if the first landing is not up to the mark.

4. **Fourth Solo (Check Free Solo):**

   a) The trainee must demonstrate the ability to land safely, in spite of adverse circumstances and dense traffic situations. The student must display a higher level of awareness and ability to cope with various situations.

   b) The instructor of the trainee need not monitor his/her approaches and landings thereafter. It is however advised that a detailed debrief be conducted after each sortie with a thorough analysis of each app& landing.

5. **Interim Check** - Every trainee must undergo a dual Check sortie with an instructor on completion of five hours of solo flying at a stretch in every phase except the Nav plase in which the dual sortie is to be flown after completing 10 hrs of flying.

6. **Cross Country Navigation Solo:**

a) A trainee is required to undergo a minimum of five long cross-country sorties (more than 100 NM on one leg) before being checked by another instructor for his/ her ability before being cleared for solo/cross country navigation sorties.

b) On being cleared for solo navigation cross-country sorties the pupil is to progress in the syllabus of cross-country navigation. However, at the end of 10 hours of solo flying the pupil must be checked by any instructor in a dual check for circuit and landing proficiency. These dual check sorties may be combined with IF/ GF as per requirement.

7. **Night flying:**

a) The night flying training of trainees can be started provided the trainee has completed a minimum of 20 hours of cross county solo navigation and 130 hours of total flying.

b) A trainee can be authorized for Solo flying by night after a minimum of two recent IF sorties (day/night) and two night flying dual sorties.

c) The trainee can be declared check free if he/ she demonstrates the ability to land safely by night after having done a minimum of three dual sorties on C&L by night of not less than 00:45 minutes each.

Night Cross Country Dual- Every trainee would be required to undergo a dual night cross-country navigation sortie as per syllabus. This sortie would be flown during the night flying training of the trainee after he/ she has completed 03:00 hours of solo night flying. This check sortie would be as per requirements of the night navigation check for the issue of CPL.

8. **Break in Flying-** Refer Flying Order No. 1.9 on currency check. Anytime, if the trainee has had a break for more than 14 days, CI/CFI is to review the case and prepare a syllabus for further progress of the trainee. The instructor of the trainee may at his discretion take up a trainee for a dual check if the break in flying has been less than 14 days depending upon the stage and performance of the pupil.