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Final investigation report on accident involving Cessna aircraft VT-FAO operated by M/s Flytech Aviation Academy on 26.02.2022 near village Thungathurthi, Nalgonda (Telangana)

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.

TABLE OF CONTENTS

SYNOPSIS 4

SUMMARY 5

1. FACTUAL INFORMATION 6

1.1 History of Flight 6

1.2 Injuries to persons 8

1.3 Damage to Aircraft 8

1.4 Other damage 8

1.5 Personnel Information 8

1.6 Aircraft Information 10

1.7 Metrological Information 17

1.8 Navigational Aids 18

1.9 Communication 18

1.10 Aerodrome information 21

1.11 Flight Recorders 22

1.12 Wreckage and Impact Information 22

1.13 Medical and Pathological Information 24

1.14 Fire 25

1.15 Survival Aspects 25

1.16 Tests and Research 25

1.17 Organizational and management information 33

1.18 Additional Information 41

1.19 Useful or effective Investigation Techniques 49

2. ANALYSIS 49

2.1 Serviceability of Aircraft 49

2.2 Weather 51

2.3 Crew Aspect 51

2.4 Organisation Aspect 52

2.5 Circumstances leading to the Accident 55

3. CONCLUSION 56

3.1 Findings 56

3.2 Probable cause of the accident 58

4. SAFETY RECOMMENDATIONS 58

Annexure A 60

Annexure B 62

Annexure C 73

SYNOPSIS

On 26th Feb 2022, M/s Flytech Aviation Academy's Cessna 152 aircraft took off for a Cross-country training flight from Nagarjunasagar overhead Raichur at 0456 UTC. Thereafter, at around 0530 UTC, while the aircraft was at 10 Nm from Nagarjunasagar Airstrip, Student Pilot contacted local ATC and requested for setting course back. Thereafter, while the aircraft was on return leg, it met with an accident near village Thungathurthy, District Nalgonda, Telangana State. Student Pilot received fatal injuries and the aircraft was completely destroyed.

The occurrence was classified as Accident as per the Aircraft (Investigation of Accidents and Incidents) Rules, 2017 vide Order INV- 11011/02/2022-AAIB dated 09.03.2022. Mr. Dinesh Kumar, Assistant Director appointed as IIC and Mr. Amit Kumar, Safety Investigation Officer, as an Investigator to investigate into the cause(s) of accident.

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 Cessna 152 Aircraft VT-FAO on 26th Feb 2022			
1.	**Aircraft**	**Type**	Cessna 152
		Nationality	Indian
		Registration	VT-FAO
2.	**Owner & Operator**		M/s Flytech Aviation Academy
3.	**No. of Persons on-board**		01 (Student Pilot)
4.	**Date & Time of Accident**		26 Feb 2022 at 0545 UTC
5.	**Place of Accident**		Near Thungathurthy Village, Peddavura Mandal, Nalgonda District
6.	**Co-ordinates of Accident Site**		Lat: 016° 42’ 19’’ N Long: 079° 14’ 19’’ E
7.	**Last point of Departure**		Nagarjunasagar Airfield
8.	**Intended place of Landing**		Nagarjunasagar Airfield
9.	**Type of Operation**		Cross Country Training Flight
10.	**Type of Occurrence**		LOC-I
11.	**Extent of Injuries**		Fatal injury

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

1. FACTUAL INFORMATION

1.1 History of Flight

On 26th Feb 2022, a Cessna 152 aircraft VT-FAO, owned and operated by M/s Flytech Aviation Academy, was scheduled for a cross-country training flight to be flown out of Nagarjunasagar Airfield (VONS) in the morning. This was the first flight of the day for the aircraft and the trainee pilot. The Pre-flight inspection was carried out by an authorized person and aircraft was released for flight.

The student pilot reported to office briefing area to prepare for cross country training exercise, which was to be flown solo under visual flight rules (VFR). As per the flight plan filed at 0422 UTC, the sortie was scheduled from Nagarjunasagar overflying Raichur back to Nagarjunasagar, with ETD 0435. Subsequently, FTO coordinated with Hyderabad ACC and flight clearance was sought on telephone for VT-FAO at time 0445 UTC. Hyderabad ACC granted necessary ATC approval for FL85 from Nagarjunasagar to Raichur and FL75 for inbound flight as requested and allotted transponder code A1221. At 0505 UTC, Hyderabad ACC received revised estimates from Flytech Aviation Academy and aircraft's Actual Time of Departure (ATD), Estimate over Raichur, and ETA VONS were updated to 0456 UTC, 0634 UTC and 0812 UTC respectively. The flight levels for both outbound and inbound remained same i.e. FL85/FL75.

As per statement from ATC personnel, he had reported around 0400 UTC at training academy, followed his routine and carried out the runway inspection. At 0415 UTC, he reported at ATC tower and thereafter ATC services were provided on VHF frequency for company aircraft.

As per the statement of FI who released the trainee for cross country training flight, the local weather at Nagarjunasagar was above the minima required for carrying out training flight, the en-route weather was also checked from the IMD website and was found conducive to undertake a cross country flight overhead Raichur.

Thereafter, Student Pilot contacted local ATC for startup clearance and requested for departure. Student Pilot was instructed for taxi to Runway 09 for takeoff. Aircraft VT-FAO took off at 0456 UTC from Runway 09 and consequently asked to report when setting course. Thereafter, Student Pilot reported downwind and setting course. ATC advised crew to report 10 Nm outbound with an altitude restriction of 3500 feet above sea level (ASL). As per ATC personnel, same was acknowledged by the Student Pilot.

On the day of the accident, four company aircraft positioned at Nagarjunasagar airfield were scheduled to conduct training flights for trainees. According to the training schedule, the aircraft VT-FAL was first in the sequence, VT-FAV was second, and the involved aircraft VT-FAO was third. The aircraft VT-FAS, which was scheduled for a training flight, was last in the sequence.

As per the statement of ATC personnel, at about 0515 UTC, while the aircraft was approximately 10 nautical miles (Nm) south west of Nagarjunasagar, the Student Pilot contacted ATC, Nagarjunasagar on frequency 122.75 MHz and requested for setting course back. ATC personnel responded "*report 05 miles inbound and field insight descend to 2500 ft*". However, as per ATC personnel's statement, the Student Pilot did not acknowledge his clearance and the reason for return asked on RT was also not answered.

As per the statement of the ATC personnel, the aircraft was expected to report its position after reaching 5 Nm inbound Nagarjunasagar, but when no call was received for approximately 5-10 minutes since last contact, he made multiple attempts to establish contact with VT-FAO. However, no response was received from aircraft VT-FAO. Meanwhile, other three aircrafts were also asked to establish contact with VT-FAO, but none of them received any response from VT-FAO.

Thereafter, local ATC contacted ATC Hyderabad at 0550 UTC and requested to explore about aircraft position. ATC Hyderabad reported that aircraft painted on Radar until 10 minutes ago and thereafter no aircraft sign was observed on Radar screen.

Later, at 0600 UTC, ATC Nagarjunasagar received information about the fatal accident from their company CFI. As per the statement of CFI, she was notified about the accident by local authorities on her mobile phone at around 0558 UTC.

As per ATC personnel at Nagarjunasagar, no distress call had been transmitted by the aircraft during the entire flight.

Further, Controller at ATC Hyderabad had also confirmed that no communication was received from VT-FAO on their ACC frequency 120.95 MHz. Hyderabad Radar data and telephone recordings were analyzed by Hyderabad ATC and no voice recordings related to VT-FAO were found. Additionally, there was no communication relayed from any other aircraft regarding VT-FAO.

Radar data revealed that RPS (Radar Position Symbol) corresponding to VT-FAO first appeared on Radar at time 05:33 UTC while the aircraft was at 10.8 Nm from Nagarjunasagar on bearing 298 with no Mode C information but after a while it dropped. Thereafter, aircraft VT-FAO reappeared on radar screen at time 0536 UTC with fluctuating Mode-C information between 3700 feet to 3200 feet AMSL and finally disappeared from screen at time 0541 UTC. At that time the RPS was observed on bearing 329 and 10.7 Nm from Nagarjunasagar with no Mode-C information.

As per witnesses' statements, the aircraft was observed flying at a low altitude and heading north, which was corroborated by radar data. Due to the proximity of a hydroelectric power plant, there are electric power transmission lines in the area. The aircraft flew alongside electric towers and performed two loitering maneuvers in search of a suitable forced landing area. But, after some time, aircraft again gained some height and was seen making a 180 degree turn and flying over a tower at a low altitude. Thereafter, it managed to fly over another section of high-tension wires but then it began descending in a nose-down attitude. A loud bang was heard in the area and cloud of dust was observed at the crash site. Immediately afterward, all eyewitnesses rushed to the accident site and informed local authorities.

Aircraft came to rest in a nose-down attitude at the place of impact. The aircraft was severely deformed by impact forces. But, the search-and-rescue satellite system did not receive any signal from aircraft's emergency locator transmitter (ELT). The student pilot received fatal injuries in the accident.

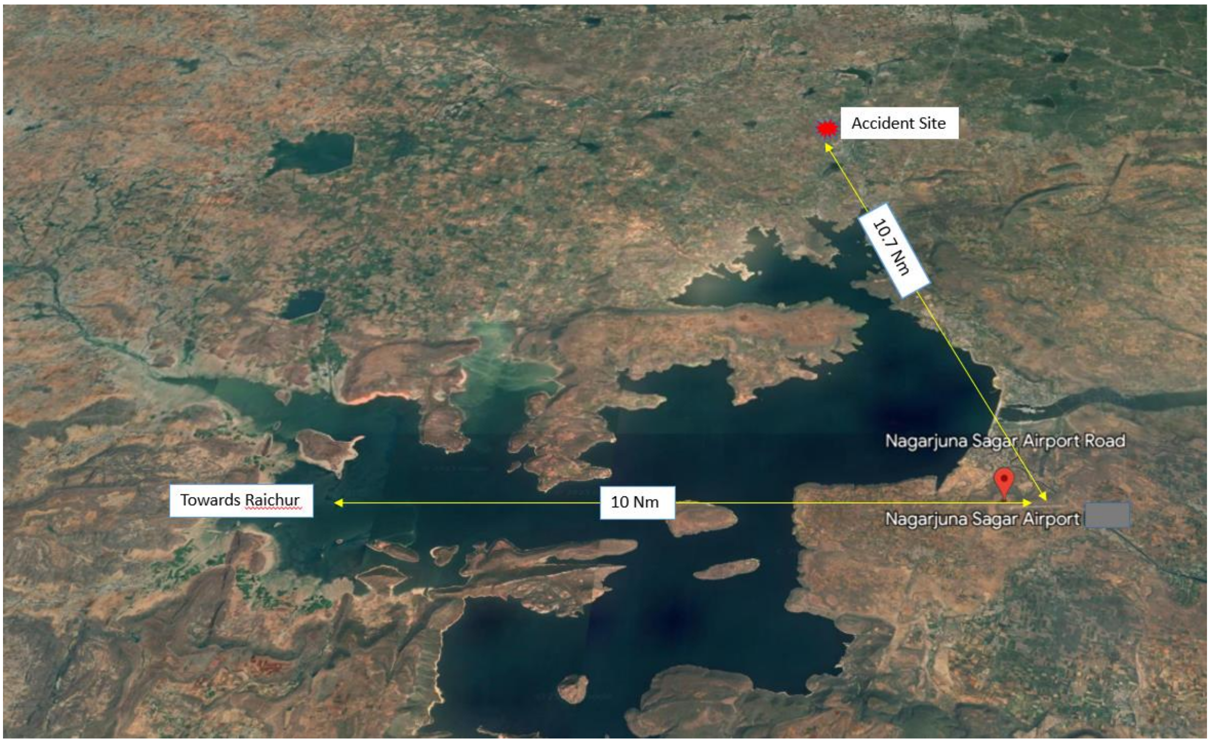


Figure 1: Accident Site

1.2 Injuries to persons

Injuries	Instructor	Trainee	Others
Fatal	Nil	01	Nil
Serious	Nil	Nil	Nil
Minor	Nil	Nil	Nil

1.3 Damage to Aircraft

The aircraft was destroyed due to impact with the ground. There was no post-impact fire.

1.4 Other damage

Nil

1.5 Personnel Information

1.5.1 Student Pilot

Nationality	Indian
Age	29 years
Date of Joining the Organisation	29-07-2021
License Type	SPL
Date of License Issued	24 Aug 2021
License valid up to	23 Aug 2026
Category	Aeroplane
Class	Single Engine Land
Date of Medical Exam	04-02-2022
Medical Validity	25-02-2023
FRTOL Date of Issue/Validity	17-09-2021/16-09-2031
RTR Date of Issue/Validity	21-06-2021/13-02-2037
Total flying experience	83:50 Hrs.
Total Experience as PIC on type	30 Hrs.
Last flown on type	25 Feb 2022

Total flying experience during last 01 Year	83:50 Hrs.
Total flying experience during last 180 days	83:50 Hrs.
Total flying experience during last 90 days	68:35 Hrs.
Total flying experience during last 30 days	39:55 Hrs.
Total flying experience during last 07 Days	15:20 Hrs.
Total flying experience during last 24 Hours	00:45 Hrs.
Rest period before the flight	13 Hrs
Last Ground Refresher	24-02-2022

After the accident, FTPR of the Student Pilot was scrutinized to assess the performance during the preceding sorties conducted under the supervision of Flying Instructors, and to ascertain the competency acquired during those training flights. The following relevant facts were observed from the FTPR:

1. First training flight 'Air Experience' for Student Pilot was performed on 19.10.2021.
2. The major exercises had already been completed for Student Pilot before he was released on his first solo cross country flight. The exercises included the following:
    a) Climbing, Descending & Gliding
    b) Medium Turns & Steep Turns
    c) Stall & Recovery
    d) Approach & Landing
    e) Various Flap Setting & Flapless approach
    f) Precautionary Landing
    g) Instrument Flight
    h) Short Nav X-Country

3. Prior to the occurrence flight, the student pilot had been authorized for, and had flown, 26 solo flights (excluding accident flight). Of those, 21 had been devoted to flying circuits, and 5 to practicing cross country training exercises including 2 flights to Raichur sector.

4. No serious negative remarks were observed in the FTPR about student pilot's flying skills. The student pilot was familiar with the enroute waypoints and topography of the Raichur route as he had flown in this sector earlier also.

1.5.2 ATC personnel

Licence	CPL
Medical	Valid
OJT/Training Experience	01 month
Experience on ATC handling	Last 03 days
Hours on duty prior to occurrence	01:40 Hrs
BA Test on the day of Accident	No

As per the statement of ATC personnel, before being assigned the role of ATC Controller, he had undergone on-the-job training (OJT) for approximately one month. After completing his training, he independently carried out the duties of an ATC controller in the Tower. He had finished his OJT three days prior to the accident, and at the time of the accident, he was the only person available in the ATC tower.

He had been employed as a controller at Nagarjunasagar since Feb 2022. On the day of the accident, which was the controller's third consecutive day of work, he started his shift at 0400 UTC.

1.5.3 AME

AME, who also holds the position of Maintenance Manager, has been employed with the organization since 2014.The details of his licenses and other relevant information is given below:

Category	B1 (Aeroplane Piston)
Licence issued on	11.01.2016
Licence valid upto	27.03.2022
Endorsement (Aircraft Type)	Cessna 152 & Cessna 172
Authorisation No.	FAA/001
Authorisation initially issued on	05.03.2016
Authorisation renewed on	03.03.2021
Authorisation valid upto	04.032022
BA Test or Drug test on the day of Accident	Yes

1.6 Aircraft Information

1.6.1 General Information: Cessna 152

Cessna 152 is a single-engine two-seat, fixed-tricycle- gear, general aviation aircraft, used primarily for flight training. The aircraft is powered by one Lycoming O235-L2C Piston Engine fitted with Sensenich 72CKS-6-0-54 fixed pitch propeller.

The construction of the fuselage is a conventional formed sheet metal bulkhead, stringer, and skin design referred to as semimonocoque.

The airplane's flight control system (see Appendix A) consists of conventional aileron, rudder, and elevator control surfaces. The control surfaces are manually operated through mechanical linkage using a control wheel for the ailerons and elevator, and rudder/brake pedals for the rudder.

The externally braced wings contain the fuel tanks. Conventional hinged ailerons and single-slotted flaps are attached to the trailing edge of the wings. The ailerons are constructed of a forward spar containing balance weights. The flaps are constructed basically the same as the ailerons, with the exception of the balance weights. The empennage (tail assembly) consists of a conventional vertical stabilizer, rudder, horizontal stabilizer, and elevator.

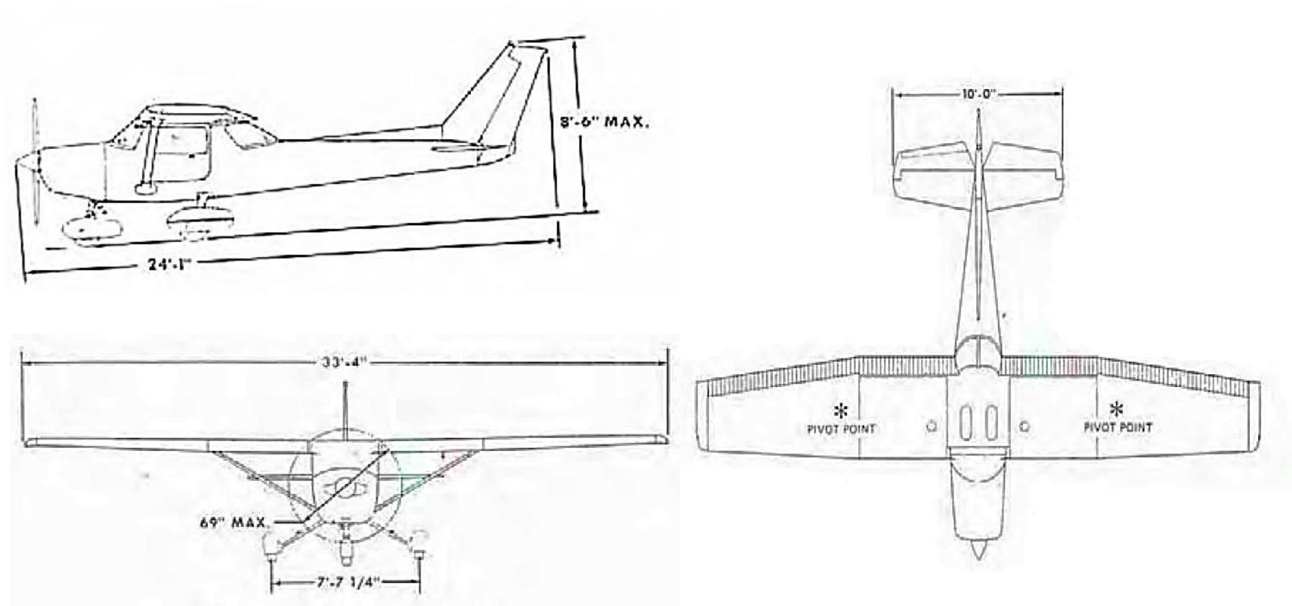


Figure 2: Aircraft dimensions

Aircraft systems or components/parts which have relevance with this accident are described below:

Trim System

A manually-operated elevator trim tab is provided. Elevator trimming is accomplished through the elevator trim tab by utilizing the vertically mounted trim control wheel. Forward rotation of the trim wheel will trim nose-down: conversely, aft rotation will trim nose-up.

Instrument Panel

The instrument panel is designed to place the primary flight instruments directly in front of the pilot. The gyro-operated flight instruments are arranged one above the other, slightly to the left of the control column. To the left of these instruments are the airspeed indicator, turn coordinator, and suction gage. The clock, altimeter, rate-of-climb indicator, and navigation instruments are above and /or to the right of the control column.

The right side of the panel also contains tachometer, ammeter, low-voltage light, and additional instruments such as a flight hour recorder.

Figure 3: Cessna 152 Cockpit (Instrument Panel)

The left switch and control panel, under the primary instrument panel, contains the fuel quantity indicators and engine instruments positioned below the pilot's control wheel. The engine controls, wing flap switch, and cabin air and heat control knobs are to the right of the pilot, at the center of the switch and control panel. Directly below these controls are the elevator trim control wheel, trim position indicator, microphone, and circuit breakers. A map compartment is on the extreme right side of the switch and control panel.

Attitude Indicator

An attitude indicator is available and gives a, visual indication of flight attitude. Bank attitude is presented by a pointer at the top of the indicator relative to the bank scale which has index marks at 10°, 20°, 30°, 60°, and 90° either side of the center mark.

Pitch and roll attitudes are presented by a miniature airplane in relation to the horizon bar.

Directional Indicator

A directional indicator is available and displays airplane heading on a compass card in relation to a fixed simulated airplane image and index. The directional indicator will process slightly over a period of time. Therefore, the compass card should be set in accordance with the magnetic compass just prior to take-off and occasionally re-adjusted on extended flights. A knob on the lower left edge of the instruments is used to adjust the compass card to correct for any precession.

Audio Control Panel

An audio control panel in an airplane comes in two types: with or without marker beacon controls. Both types have similar features and are discussed in the following paragraphs.

Transmitter Selector Switch

When more than one NAV/COM radio is installed in the airplane, it is necessary to select the radio unit the pilot desires to use for transmitting. To accomplish this, a transmitter selector switch is provided on the audio control panel. The switch is either a two-position toggle-type or a three-position rotary-type depending on which audio control panel is installed. Both switches are labeled with numbers which correspond to the top (number 1) or the bottom (number 2) NAV/COM radio. Position 3 is not used in this airplane.

The audio amplifier in the NAV/COM radio is required for speaker and transmitter operation. The amplifier is automatically selected, along with the transmitter, by the transmitter selector switch. As an example, if the number 1 transmitter is selected, the audio amplifier in the associated NAV/COM receiver is also selected, and functions as the amplifier for ALL speaker audio. In the event the audio amplifier in use fails, as evidenced by loss of all speaker audio and transmitting capability of the selected transmitter, select another transmitter. This should re-establish speaker audio and transmitter operation. Since headset audio is not affected by audio amplifier operation, the pilot should be aware that, while utilising a headset, the only indication of audio amplifier failure is loss of the selected transmitter. This can be verified by switching to the speaker function.

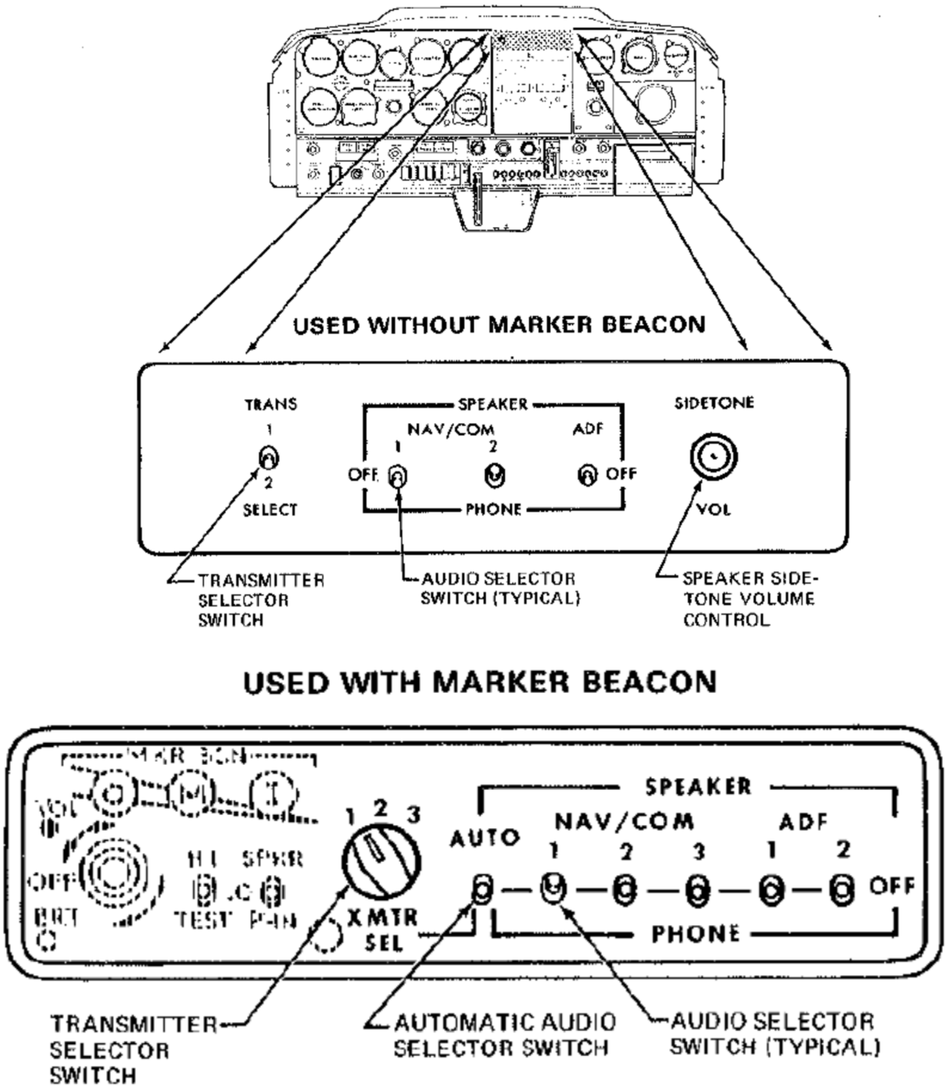


Figure 4: Audio Control Panel

Audio Selector Switches

Both audio control panels incorporate an individual three-position, toggle-type audio selector switch for each NAV/COM or ADF radio installed in the airplane. These switches allow the audio of any receiver to be directed to the airplane speaker or to the headset individually. To hear the audio of any particular receiver over the airplane speaker, place the audio selector switch associated with that receiver (NAV/COM or ADF) in the up (SPEAKER) position. To listen to the receiver through the headset, place the appropriate audio selector switch in the down (PHONE) position. To turn off the audio on that receiver, place the audio selector switch in the center (OFF) position. Thus, any NAV/COM or ADF receiver may be heard singly or in combination with other receivers, either over the airplane speaker or the headset.

Automatic Audio Selector Switch

If the airplane is equipped with an audio control panel having marker beacon controls, a toggle switch, labeled AUTO, is provided and can be used to automatically match the appropriate NAV/COM receiver audio to the transmitter being selected. To utilize this automatic feature, leave all NAV/COM receiver switches in the OFF (center) position, and place the AUTO selector switch in either the SPEAKER or PHONE position, as desired. Once the AUTO selector switch is positioned, the pilot may then select any transmitter and its associated NAV/COM receiver audio simultaneously with the transmitter selector switch. If automatic audio selection is not desired, the AUTO selector switch should be placed in the OFF (center) position.

NOTE: Cessna radios are equipped with sidetone capability (monitoring of the operator's own voice transmission). Sidetone will be heard on either the airplane speaker or a headset as selected with the AUTO selector switch. Sidetone may be eliminated by placing the AUTO selector switch in the OFF position, and utilizing the individual radio selector switches.

Fuel System

The aircraft was equipped with standard fuel system consists of two vented fuel tanks (one in each wing), a fuel shutoff valve, fuel strainer, manual primer, and carburettor.

Fuel flows by gravity from the two wing tanks to a fuel shutoff valve and fuel system venting is essential to system operation.

Fuel quantity is measured by two float-type fuel quantity transmitters (one in each tank) and indicated by two electrically- operated fuel quantity indicators on the lower left portion of the instrument panel. An empty tank is indicated by a red line and the letter E. When an indicator shows an empty tank, approximately 0.75 gallon remains in either a standard or long range tank as unusable fuel. The Indicators cannot be relied upon for accurate readings during skids, slips, or unusual attitudes.

Vacuum System and Instruments

An engine-driven vacuum system is available and provides the suction necessary to operate the attitude indicator and directional indicator.

The system consists of a vacuum pump mounted on the engine, a vacuum relief valve and vacuum system air filter on the aft side of the firewall below the instrument panel, and instruments (including a suction gage) on the left side of the instrument panel.

Suction Gauge

A suction gauge is located on the left side of the instrument panel when the airplane is equipped with a vacuum system. Suction available for operation of the attitude indicator and directional indicator is shown by this gauge, which is calibrated in inches of mercury. The desired suction range is 4.5 to 5.4 inches of mercury. A suction reading below this range may indicate a system malfunction or improper adjustment, and in this case the indicators should not be considered reliable.

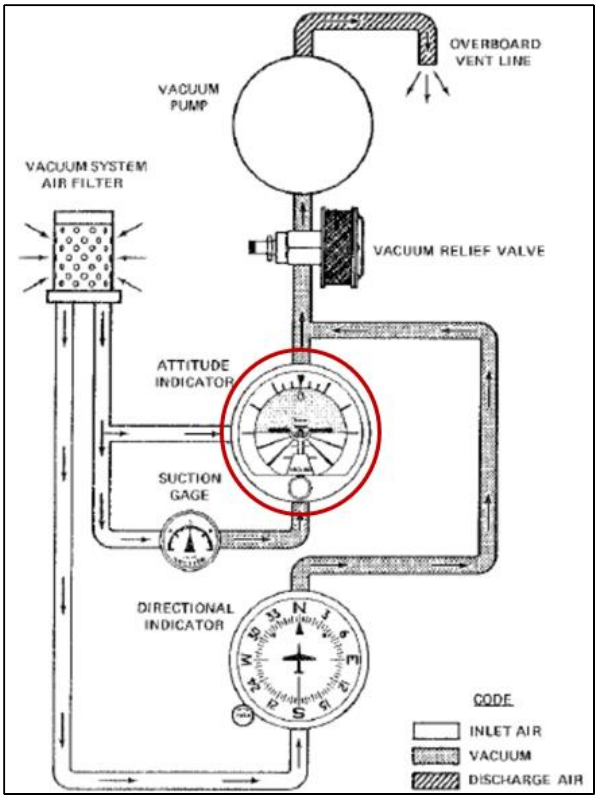


Figure 5: Vacuum System

1.6.2 Aircraft Specific Information (VT-FAO)

The aircraft is registered under category 'Normal' with sub category 'Passenger' and the minimum number of crew specified to operate this aircraft is 'ONE' as per its C of A.

Aircraft was manufactured in the year 1979. And the aircraft was inducted in this organization on 25.02.1997 and since thereafter, it was utilized for training flying activities.

Aircraft Model	Cessna 152
Aircraft S. No. (MSN)	15282478
Year of Manufacture	1979
Name of Owner	M/s Flytech Aviation Academy
C of R	2897/2, issued on 20.05.2019
C of A	2314, Valid
Category	Normal/Passenger
ARC issued on	21 Jan 2022
ARC valid up to	22 Jan 2023
Aircraft Empty Weight	560.8 Kg
Maximum Take-off weight	760 Kg
Date of Aircraft weighment	25 April 2010
Max Usable Fuel	Main tank: 92.73 Litres Aux. tank: 55.26 Litres
Max Pay load with full fuel	7.66 Kg
Operating Empty Weight CG	79.18 cm aft of Datum
Total Aircraft Hours	21123:31 Hrs
Last major inspection	Operation 3 at 21122:01 Hrs
List of repairs carried out after last scheduled inspection 200 hrs carried out on 09.07.2021 till date of accident	Nil
Engine Type	Lycoming O-235L2C
Date of Manufacture	30-11-1977
Engine Sl. No.	L-14614-15
Last major inspection	Operation 3 at 25248:59 Hrs
List of repairs carried out after last scheduled inspection 200 hrs carried out on 09.07.2021 till date of accident	Nil
Total Engine Hours	25250:29 Hrs.
Aero mobile License	A-338/06 valid upto 31 Dec 2023
AD, SB, Modification complied	Complied

As per aircraft logbook: Last Mandatory Mod complied on the aircraft was DGCA/Cessna 152/04 on 20.02.2022 at 21098:11 airframe hours.

Inspection Schedules (Operations)

Most of the Inspection schedules cover one or more task pertaining to control systems such as Flaps, Aileron, Elevator, Elevator Trim and Rudder. The inspection schedules which have inspection task for control surfaces are Operation 1, Operation 2, Operation 3, Operation 4, Operation 9, Operation 14, Operation 22 and Operation 24. Out of these inspection schedules Operation 9 is a critical inspection and it covers Aileron related inspection. Operation 24 is basically, a 600 hrs/12 month's inspection schedule, which exhaustively cover the inspection on all control systems. In Operation 24, maintenance personnel have to ensure the serviceability of control surfaces by measuring and verifying the essential aspect of the control system such as travel & cable tension from the standard values.

Aircraft Inspection Schedules

During investigation, Aircraft Inspection Schedules (Operations) have been scrutinized and following have been observed:

1. In the preceding two years from the date of accident, Operation 24 / 600hrs/12 month's inspection was carried out four times on the aircraft VT-FAO. However, no malfunctions were observed during these inspections, hence **nil components were replaced.**
2. The inspection sheet filled out during the Operation 24 / 600 hrs/12 month's inspection on 19 February 2020, was found to be incomplete. Specifically, the maintenance personnel had omitted checking the travel, cable tension, and travel time of the Flaps.
3. For the Operation 24 / 600 hrs/12 months' inspections conducted on 15 February 2021, and 08 September 2021, the maintenance personnel recorded the rudder cable tension as 20 lbs. However, the rudder cable is spring loaded and there is no requirement to measure the rudder cable tension.
4. Inspection sheet filed during Operation 24 / 600 hrs/12 month's inspection on 13 Feb 2022 was also observed to be incomplete as the Flap travel was not checked for 10° and 20° position. The inspection sheet was filled for flap 30° only.
5. During ARC renewal in the month of Jan 2022, Operation 2, Operation 22, Operation 3 and Fuel gauge system inspection were carried out. Operation 4, Trim tab actuator cleaning and lubrication were carried out post ARC renewal.
6. On 24 Feb 2022, scheduled inspection (Operation 22) was carried out as per procedure sheet at 21116:51 airframe hours. Further, as per work call out No. 2022/58 dated 05.02.2022, vacuum pump vane indication inspection was carried out on the same day at 21116:51 hrs. No discrepancies were noted by the maintenance personnel.
7. Last Scheduled inspection (Operation 3) was conducted on 25.02.2022 at 21122:01 airframe hrs. Following this inspection, aircraft flew for another 01.30 hrs, excluding the accident flight time.

Technical logbook

Scrutiny of Technical records of the aircraft revealed the following issues regarding maintenance:

1. Scrutiny of the PDR revealed that after the aircraft's ARC was renewed on 21 January 2022, no defects were recorded therein.
2. As per entries made in the Defect Register, the last defect was registered on 12.08.2021, wherein Vacuum pump coupling had sheared off & pump was not rotating. It was replaced with new dry air pump under unscheduled maintenance.
3. As per OEM, Vacuum pump vane wear indication inspections are required to be performed, initially after 600 hrs of installation, then as per inspection outcome at (1000 hrs/ 800 hrs or 700 hrs) and thereafter, at or before every 100 hrs. As per the maintenance records, Vacuum pump was installed on the aircraft during defect rectification on 12.08.2021 and inspected on 02.02.2022 at 600 hrs (component life). Thereafter, Vacuum pump vane wear indication inspections was carried out at 100 hrs (component life) instead of OEM's recommended hrs (1000 hrs/800 hrs or 700 hrs). While the inspection was not carried out as per the prescribed schedule, the same was

carried out every 100 hrs. However, the reason for increasing the frequency was not documented.

4. The examination of the Journey Logbook obtained from the accident site revealed that the date, pilot acceptance, place, and time of departure were not recorded in the appropriate sections before the cross-country flight on 26 February 2022. Additionally, the readings provided in the oil upliftment section of the logbook were found erroneous.

Fuel and oil records

To know about the aircraft's fuel status on the day of accident, different records were verified and following was observed:

1. Total Fuel uplifted on 24 Feb 2022, was 125 liters and thereafter aircraft had performed 04 sorties on the next day i.e. on 25 Feb 2022.
2. Fuel left after those 4 sorties was 65 liters (25 Feb 2022).
3. As per company's standard practice, on 25 Feb 2022, fuel topped up was 25 liters after completion of the last sortie of the day (65+25= 90 litres).
4. On 26th Feb 2022, aircraft commenced its first flight of the day with 90 litres of fuel on board (accident flight).
5. Aircraft fuel consumption rate for the month of Feb was found 17.47 lt/hrs, which is within the norms.

ELT Records

Further, to ascertain about the serviceability of the ELT installed in the aircraft, relevant documents were checked. Based on the records, it has been verified that the ELT was installed on aircraft on 13.04.2010 and its last annual inspection was carried out on 19.11. 2021. As per the records, ELT battery was due on 21.07.2025.

1.7 Metrological Information

Nagarjunasagar is an uncontrolled airfield and therefore, does not have any MET facility at airfield. As per the Met register maintained by M/s FAA at Nagarjunasagar airfield, weather forecast and trends of two stations namely Hyderabad (VOHS) & Vijayawada (VOBZ) is being recorded. On the day of accident, Met information recorded for both the stations is as follows:

Station	Time (UTC)	Winds	Visibility	Clouds	Temp(˚C)	QNH	Forecast
VOHS	0400	110/10 Kt	5000 m Hz	NSC	25/14	1020	NOSIG
	0700	120/11 Kt	6000 m	NSC	30/12	1018	NOSIG
	1000	100/08 Kt	6000 m	NSC	31/10	1015	NOSIG
VOBZ	0400	070/06 Kt	3500m Hz	FEW 020 SCT 100	25/20	1017	NOSIG
	0700	180/05 Kt	6000 m	FEW 020 SCT 025	31/17	1015	NOSIG
	1000	070/06 Kt	6000 m	SCT 020	32/16	1012	NOSIG

As per the records, visibility at Hyderabad airport, located towards North-West in respect of Nagarjunasagar airfield, was above minima and no significant weather change was reported. As per company's laid down procedures, METAR for both the stations is updated with the help of IMD website and enroute weather is observed online. However, no weather information for base and *enroute* was found recorded in Met register being maintained at Nagarjunasagar airfield.

To ascertain, whether on the day of accident, enroute weather was conducive to undertake cross country training flight overhead Raichur, investigation team had sought assistance of IMD. The Radar images covering an area of 250 Km was shared with AAIB. The Radar image of 0502 UTC provided by Hyderabad IMD are shown in Fig 6 & Fig 7.

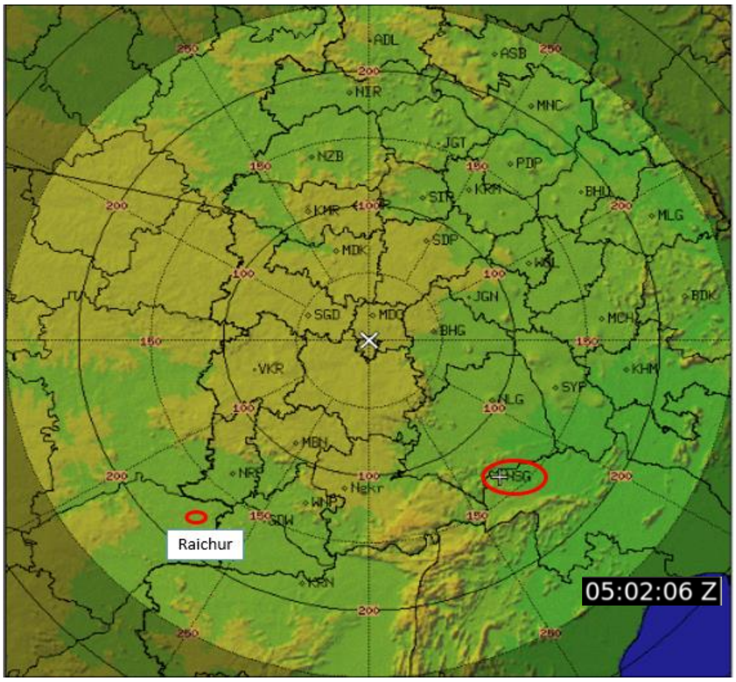


Figure 6: Radar image (weather)

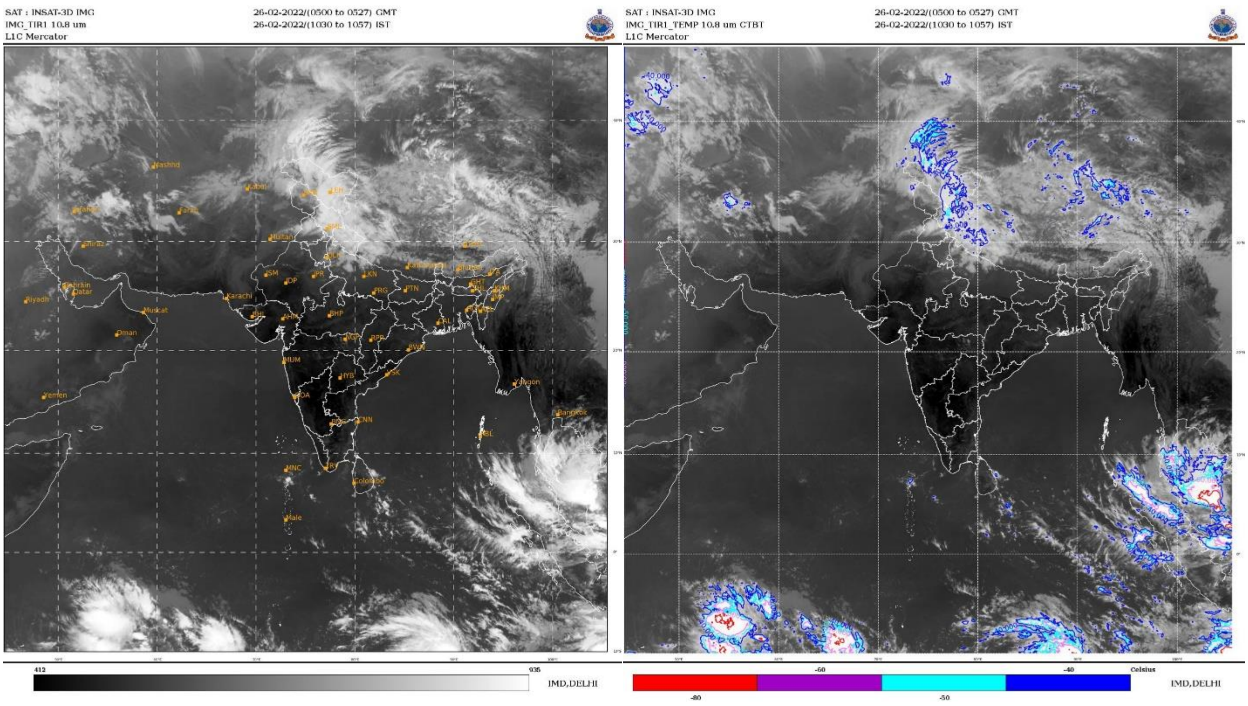


Figure 7: Overall Weather on the day of Accident

1.8 Navigational Aids

Nagarjunasagar airfield with Runway orientation 27/09 is a "Visual Approach Runway" and no navigational aid for landing is installed.

1.9 Communication

Aircraft was fitted with a VHF radio set to cater for communication while flying. The communication is being done through the help of RT.

At the time of the accident, one company person manning the tower was providing ATC services at Nagarjunasagar airfield. As per his statement, aircraft had always maintained positive two-way communication on local frequency 122.75 MHz during the flight until last transmission made around 0515 UTC. As per the ATC, the last transmission received from aircraft was “10 Nm request set course back to VONS”. Permission was granted and ATC responded “*Report 5 miles inbound field insight descend to 2500”*. However, this transmission was not acknowledged by Student Pilot as stated by personnel manning the Nagarjunsagar ATC. But, as per student pilots who were flying in different sectors, aircraft VT-FAO had responded to the call made by ATC.

As per ATC personnel, the intention of Student Pilot was asked before permission was granted to set course back while the aircraft was at 10 Nm outbound, but none of the crew from other aircraft operating in the vicinity stated to have observed this transmission on RT during interviews with the Investigation team.

As there is no mechanism in place at Nagarjunasagar ATC tower to record and retrieve the communication held between ATC tower and aircraft, therefore in absence of RT calls recording, reasons for discrepancy in statements of ATC personnel, Student Pilots and Instructor could not be ascertained.

The hotline communication held between FTO and ATC Hyderabad for information and clearance purpose prior to take off from Nagarjunasagar was recorded by ATC Hyderabad. After the accident, the tape transcript of the same was made available to investigation team for the purpose of investigation. Communication relevant to this accident is provided below:

TRANSCRIPT OF TELEPHONE CALLS BETWEEN HYDERABAD AREA AND FLYTECH AVIATION ACADEMY ON 26.02.2022 BETWEEN 04:45 UTC TO 07:15 UTC

TIME	FROM	TO	TEXT
04:45:02	FLYTECH AVIATION	HYDERABAD AREA	GOOD MORNING MADAM CALLING FROM NAGARJUNA SAGAR (GARBLED)
	HYDERABAD AREA	FLYTECH AVIATION	CAN YOU REPEAT LOUDER I AM UNABLE TO HEAR YOU
	FLYTECH AVIATION	HYDERABAD AREA	MAM AM I AUDIBLE NOW
	HYDERABAD AREA	FLYTECH AVIATION	READABILITY THREE MAM
	FLYTECH AVIATION	HYDERABAD AREA	CAN YOU HERE ME BETTER NOW
	HYDERABAD AREA	FLYTECH AVIATION	SOMEWHAT. GO AHEAD 'VT'
	FLYTECH AVIATION	HYDERABAD AREA	‘FAO1’
	HYDERABAD AREA	FLYTECH AVIATION	FOA1 YEAH IT IS FROM NAGARJUNA SAGAR OVER FLYING WHAT POINT
	FLYTECH AVIATION	HYDERABAD AREA	RAICHUR MAM
	HYDERABAD AREA	FLYTECH AVIATION	RAICHUR ONE SECOND. WHAT IS THE LEVEL REQUESTING
	FLYTECH AVIATION	HYDERABAD AREA	85 75 MADAM
	HYDERABAD AREA	FLYTECH AVIATION	85 AND 75 EXPECTED TIME OF DEPARTURE

TIME	FROM	TO	TEXT
	FLYTECH AVIATION	HYDERABAD AREA	0435
	HYDERABAD AREA	FLYTECH AVIATION	04
	FLYTECH AVIATION	HYDERABAD AREA	0450
	HYDERABAD AREA	FLYTECH AVIATION	0450. NAGARJUNA SAGAR TO NAGARJUNA SAGAR OVERFLYING RAICHUR
	FLYTECH AVIATION	HYDERABAD AREA	AFFIRM
	HYDERABAD AREA	FLYTECH AVIATION	OUTBOUND 75 CORRECTION 85 INBOUND 75. OKAY
	FLYTECH AVIATION	HYDERABAD AREA	OUTBOUND 85 INBOUND 75
	HYDERABAD AREA	FLYTECH AVIATION	YES YES SQUAWK WILL BE 1221 AND CLEARANCE EXPIRY TIME WILL BE 0456
	FLYTECH AVIATION	HYDERABAD AREA	OKAY MADAM
	HYDERABAD AREA	FLYTECH AVIATION	AFTER AIRBORNE PASS THE ESTIMATES TO US OKAY
	FLYTECH AVIATION	HYDERABAD AREA	YES MADAM
	HYDERABAD AREA	FLYTECH AVIATION	1219 AND ONLY ONE PERSON ON BOARD
	FLYTECH AVIATION	HYDERABAD AREA	OHH YES MADAM
	HYDERABAD AREA	FLYTECH AVIATION	OKAY INFORM ME AFTER AIRBORNE AND ESTIMATES OKAY
04:46:22	FLYTECH AVIATION	HYDERABAD AREA	YES MADAM
05:05:08	FLYTECH AVIATION	HYDERABAD AREA	HELLO
	HYDERABAD AREA	FLYTECH AVIATION	YES
	FLYTECH AVIATION	HYDERABAD AREA	GOOD MORNING MADAM CALLING FROM NAGARJUNA SAGAR
	HYDERABAD AREA	FLYTECH AVIATION	YES SIR GO-AHEAD
	FLYTECH AVIATION	HYDERABAD AREA	PASSING ESTIMATES FOR ‘VTFAO1’
	HYDERABAD AREA	FLYTECH AVIATION	01 GO AHEAD
	FLYTECH AVIATION	HYDERABAD AREA	DEPARTURE FROM NAGARJUNA SAGAR 0456
	HYDERABAD AREA	FLYTECH AVIATION	0456
	FLYTECH AVIATION	HYDERABAD AREA	ESTIMATING RAICHUR 0634
	HYDERABAD AREA	FLYTECH AVIATION	RAICHUR 0634
	FLYTECH AVIATION	HYDERABAD AREA	ETA BACK AT NAGARJUNA SAGAR 0812 MAM
	HYDERABAD AREA	FLYTECH AVIATION	0812

TIME	FROM	TO	TEXT
	FLYTECH AVIATION	HYDERABAD AREA	AFFIRM MADAM
	HYDERABAD AREA	FLYTECH AVIATION	OKAY YOU HAVE TO INFORM THIS TO CHENNAI FIC AND MANGALORE
05:06:01	FLYTECH AVIATION	HYDERABAD AREA	CHENNAI FIC OKAY MAM
07:14:40	HYDERABAD AREA	FLYTECH AVIATION	CALLING FROM HYDERABAD AREA
	FLYTECH AVIATION	HYDERABAD AREA	YES MAM, GO AHEAD
	HYDERABAD AREA	FLYTECH AVIATION	MAM HOW MANY PERSONS ON BOARD ON FAO
	FLYTECH AVIATION	HYDERABAD AREA	01
	HYDERABAD AREA	FLYTECH AVIATION	ONLY ONE PERSON RIGHT
	FLYTECH AVIATION	HYDERABAD AREA	YES MAM
	HYDERABAD AREA	FLYTECH AVIATION	DO YOU HAVE ANY INFORMATION OTHER INFORMATION REGARDING THIS
	FLYTECH AVIATION	HYDERABAD AREA	REGARDING
	HYDERABAD AREA	FLYTECH AVIATION	REGARDING THE AIRCRAFT
	FLYTECH AVIATION	HYDERABAD AREA	REGARDING THE AIRCRAFT, YEAH MAM GO AHEAD I AM CAPTAIN HERE
	HYDERABAD AREA	FLYTECH AVIATION	WHAT IS THE POSITION WE HAVE GOT INFORMATION THAT IT GOT CRASHED SOME WHERE
	FLYTECH AVIATION	HYDERABAD AREA	YEAH MAM, WE ARE GETTING THE INFORMATION LIKE THAT, OUR PEOPLE ARE (GARBLED)
	HYDERABAD AREA	FLYTECH AVIATION	WAIT ONE SEC, ANY CAUSALITY INFORMATION MAM
	FLYTECH AVIATION	HYDERABAD AREA	NO MAM, AS OF NOW WE DIDN’T
	HYDERABAD AREA	FLYTECH AVIATION	01 PERSON ON BOARD RIGHT
	FLYTECH AVIATION	HYDERABAD AREA	YES

1.10 Aerodrome information

The Nagarjunasagar airfield is an uncontrolled airfield located adjacent to Krishna River and handed over to Flytech Aviation Academy on a lease for a period of 33 years from the date of execution of agreement which was signed on 28 Feb 2009.

Declared distances

Runway	Threshold co-ordinates	Distance (feet)	Width (feet)
09 (090°M)	16°32’422”N 079°18’839”E	3200	76
27 (270°M)	16°32’438”N 079°19’354”E	3200	76

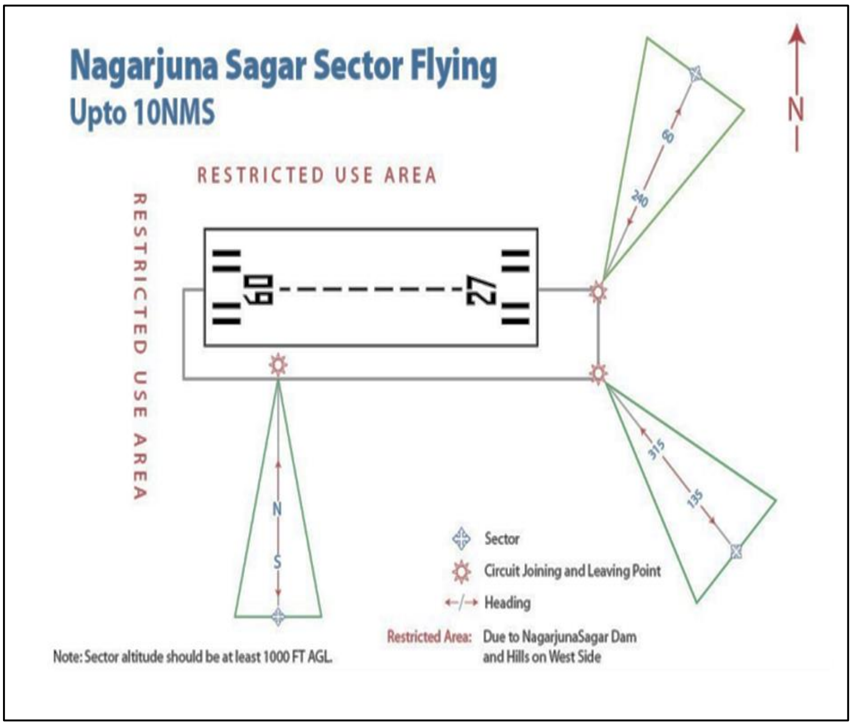


Figure 8: Runway Orientation

The airfield is primarily utilized by FAA under VFR to impart flying training to student pilots and the airfield is also equipped with night operations facility. It has one airstrip with orientation 27/09 and its elevation is 658 feet (AMSL). 3 Nm north of airfield has been declared as no fly zone due to proximity with the Nagarjunasagar Dam.

1.11 Flight Recorders

No flight recorder was installed on the aircraft. DGCA's Civil Aviation Regulations does not mandate the same as per CAR Section 2 Series I Part V.

1.12 Wreckage and Impact Information

Based on eyewitness statements, the aircraft initially followed a path alongside the electric towers, as depicted in Figure No. 9. Subsequently, the aircraft descended and performed two

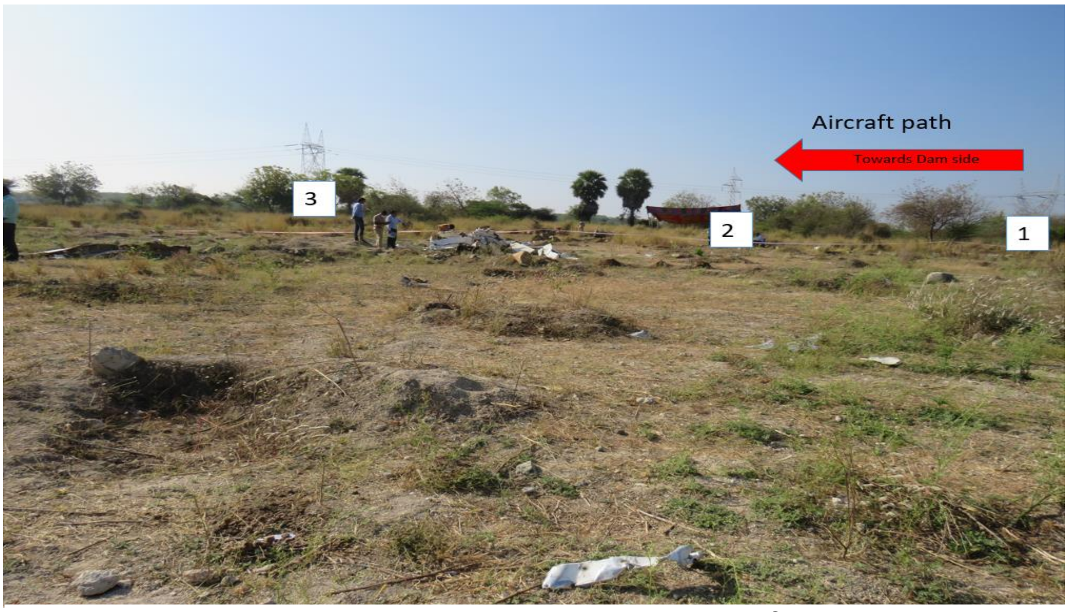


Figure 9: Aircraft path before making 180^{o} turn

loitering maneuvers. However, aircraft again gained some height and subsequently made a 180 degree turn. According to eyewitnesses, following the 180-degree turn, the aircraft continued along the trajectory (Figure 9).

As per the statement of one eye witness who was present near tower No. 1, the aircraft was flying at low altitude while maintaining a marginal clearance from the tower no. 1. Thereafter, aircraft continued to fly over the section of the electric wires present ahead, again continuing to maintain a marginal gap. Although, the aircraft avoided contact with the electric wires, it was observed by the witness that the aircraft started moving in nose down attitude. Shortly, the aircraft collided with ground resulting in formation of a dust cloud at the crash site. The impact occurred at the location identified as No. 3 on Figure 10.

Figure 10: Aircraft path after making 180^0 turn [1. Newly installed Tower, 2. Electric wires & 3. Point of Impact]

The wreckage of aircraft was found on a barren land. After examination of crash site, it has been observed that forward section along with the fuselage was severely deformed, consistent with a high-energy collision with the ground along the aircraft's longitudinal axis. The aircraft had come to rest in a nose-down attitude.

Both wings had ripped off from main fuselage after they struck the ground. The empennage had separated from the airframe and was found behind the aft section of the fuselage, indicating that the separation had occurred on impact with the ground. Pilot seat got separated and found beside the main wreckage.

The engine got separated from the firewall completely and found at a distance of approximately 17 feet from the main wreckage. Propeller hub of each blade was found stuck into the ground adjacent to damaged engine and were found broken from the center mount. RH main landing gear tyre was found detached from the assembly hub. Further, tyre groves were found beyond the limits. Some of the wreckage photographs are provided at the Annexure D of the report.

Figure 11: Aircraft Tyre

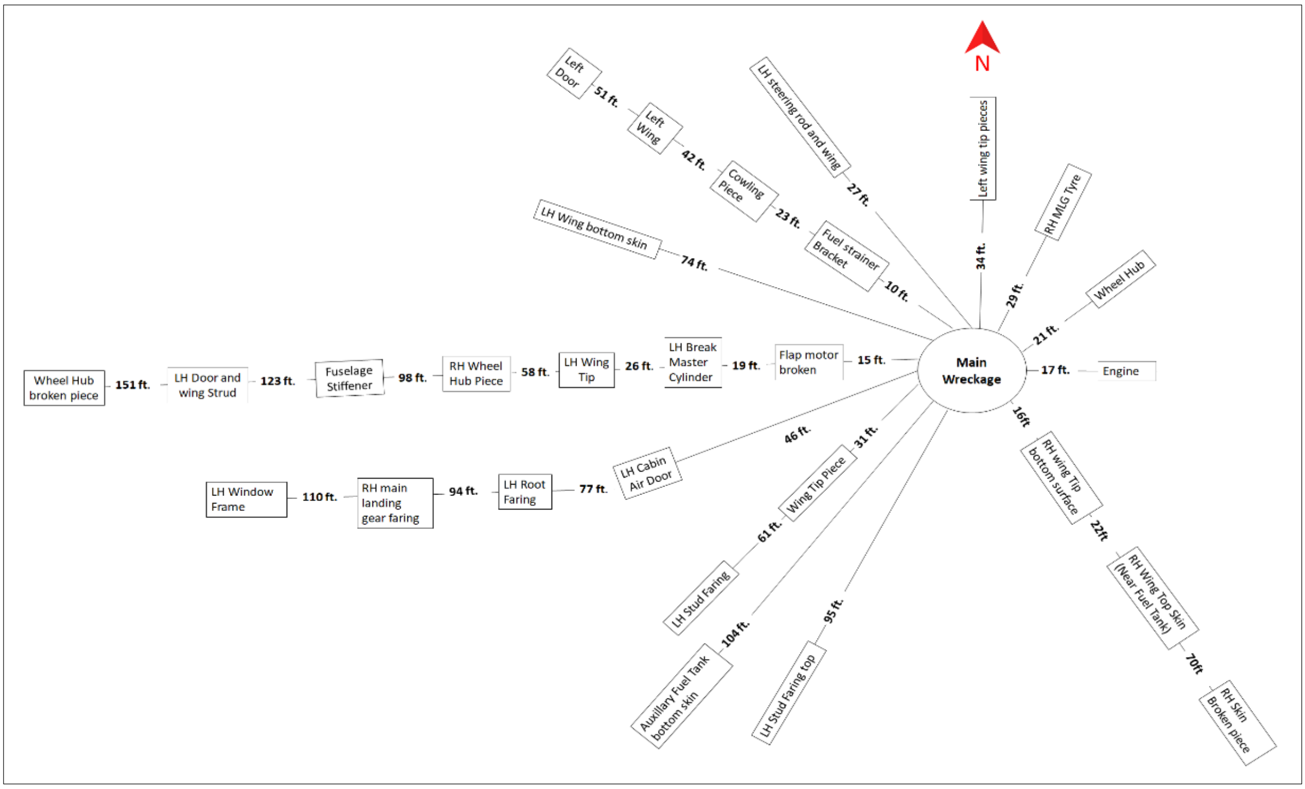


Figure 12: Wreckage distribution diagram

All the aircraft parts scattered in the area were identified. Based on their locations at the crash site, an aircraft wreckage diagram was plotted (Fig 12). It was found that aircraft parts were scattered up to 151 feet apart from the main wreckage, corroborating with the fact that it was a high-energy impact at the site.

Figure 13: Aircraft Main Wreckage and Engine Wreckage

1.13 Medical and Pathological Information

Student Pilot was not subjected to Breath Analyzer test before being authorized to commence training sortie. However, as per the records maintained at Nagarjunasagar airfield, BA declaration was signed by student pilot stating that the pilot was not under the influence of alcohol or any psychoactive substance.

The post mortem for the deceased pilot was carried out at local government hospital. The post mortem report concluded that cause of the death was polytrauma.

In accordance with DGCA CAR Section 5 Series F Part IV, 10% of Engineering personal shall be subjected to BA test before once they report at the organization. Hence, on the day of accident, 10% technical staff of the organization underwent BA examination including the AME who carried out preflight inspection. As per the BA test records, no engineering personnel was found BA positive.

As the CAR does not mandate BA examination for ATC personnel providing ATC services in FTO's, the person manning ATC tower was not subjected to BA test.

1.14 Fire

There was no pre or post impact fire.

1.15 Survival Aspects

The accident was not survivable due to severe impact.

1.16 Tests and Research

1.16.1 Engine Strip Examination

The engine was shipped to the OEM to carry out the strip examination at their facility in USA. The content of the tear down report along with the findings of the OEM are as follows:

- The metal fixed pitch propeller was found fractured through the center of the propeller hub. Both blades exhibited damage in the form of chord wise scratching, leading edge damage and gouging, and S-bending to the overall propeller.
- Blade "A" exihbited bending, cordwise scratching on the first 16", along with tip damage in the form of bending and gouging.

Figure 14: Blades labeled "A" and "B"

- Blade "B" exihbited overall bending with cord wise scatching, leading edge polishing, and twisting of the blade towards the tip.
- Carburetor suffered a high amount of impact damage and could not be fully evaluated. The floats were of the plastic type and one float was impact separated from the unit.

- Both magnetos suffered high amounts of impact damage and could not be tested for spark or operational condition.

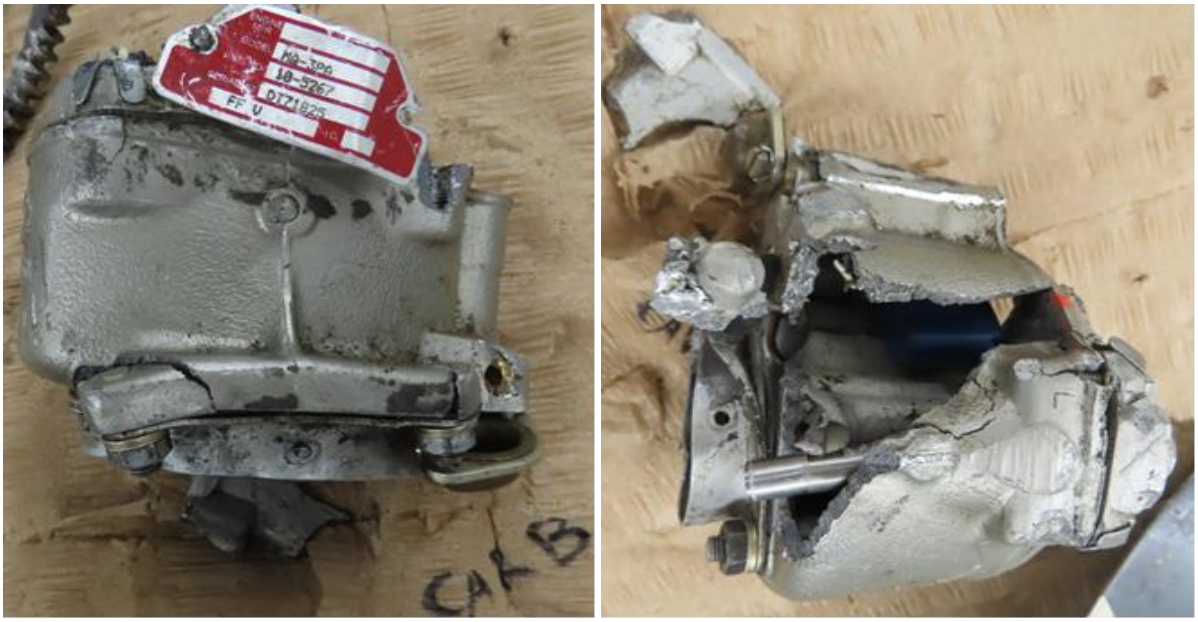


Figure 15: Carburetor

Figure 16: Magneto

- Sparkplugs showed normal wear and coloration consistent with normal engine operation. Bottom plug on cylinder 2 was impact separated from the cylinder and could not be examined further. Plugs on cylinder 1 and 3 had debris from the impact and combustion deposits present.

Figure 17: Spark Plug

- Harness sustained a high amount of damage in the form of cuts and abrasion consistent with impact damage and could not be tested.
- Data plate was not legible on the starter housing. The rear of the unit was found fractured and damaged. The front of the housing showed signs of gouging and swiping of the surface consistent with contact of the starter ring gear during engine rotation.

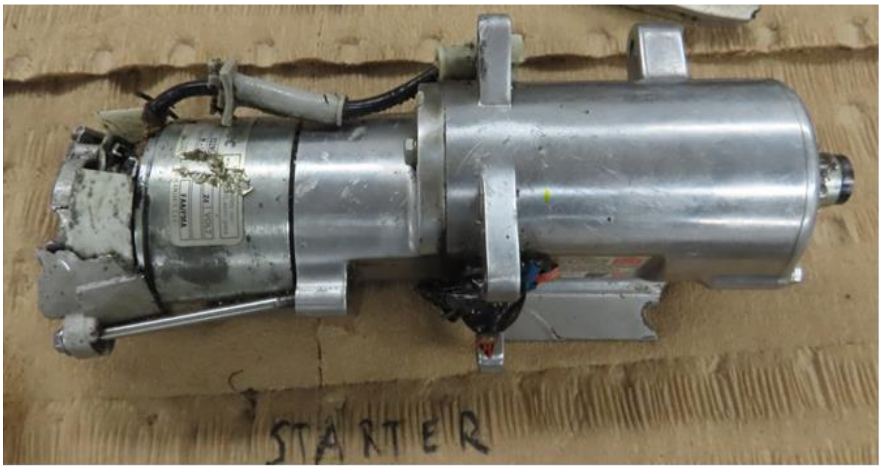


Figure 18: Starter

- Alternator was highly fragmented and could not be further evaluated. Vacuum pump disassembled and rotor showed cracks throughout.

Figure 19: Vacuum pump

- Oil system could not be evaluated as the oil filter suffered high impact damage and a portion of filter element could not be gathered for evaluation. The oil suction screen was not present at the exam and could not be evaluated. No signs of a lack or loss of lubrication was observed throughout the engine exam on any of the bearings or rotating surfaces. A portion of the oil pump housing was present and one of the oil pump gears impacted the housing consistent with hard ground impact which left an imprint of the gear. This imprint showed swiping of

Figure 20: Oil Filter & Oil Pump Housing

the material consistent with rotation.

- Oil pump housing and material gouging/swiping
- The cylinders were removed, and crankcase was separated along its fractures.

Figure 21: Crankshaft

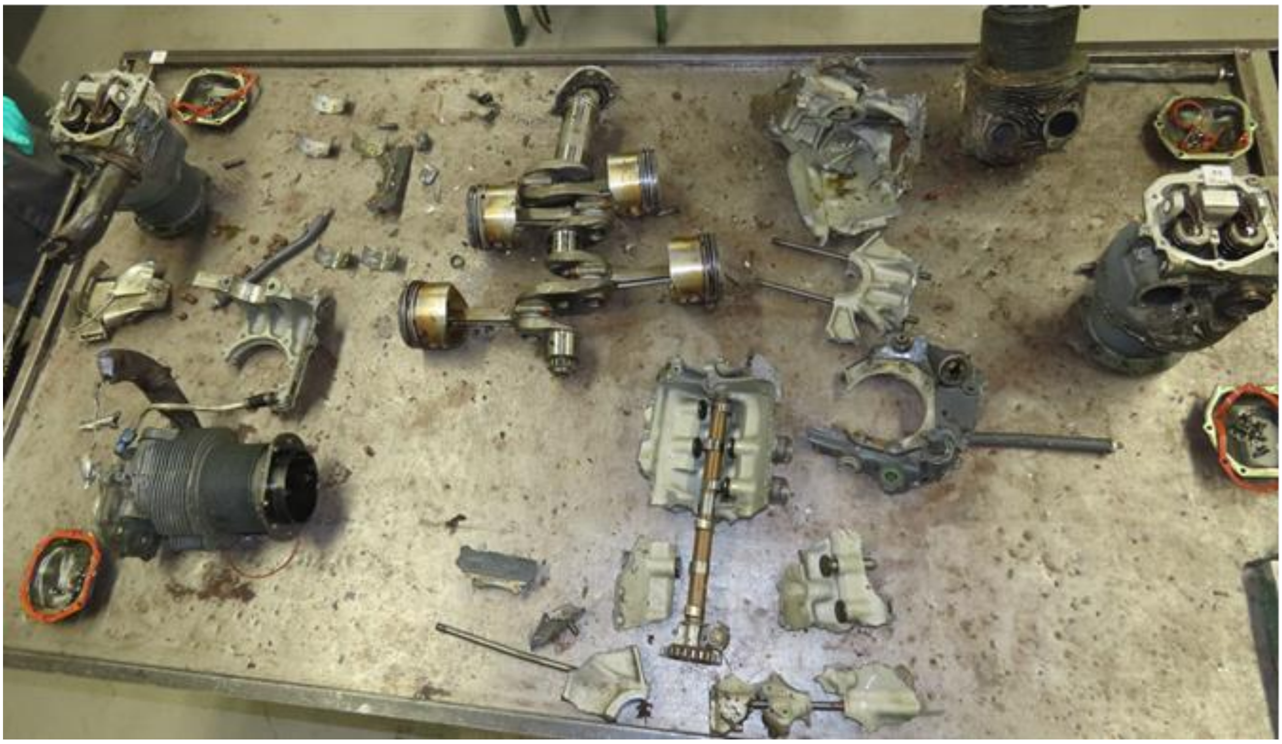


Figure 22: Cylinder & Piston

- All connecting rods were removed from the crankshaft except for the number 1. The crankshaft suffered an approximate 8 degree bend which pinched the connecting rod onto the crankshaft journal. The connecting rods bearing were removed (7 out of 8) and examined. No lack or loss of lubrication conditions were observed, and the surface of the available bearings were found unremarkable.

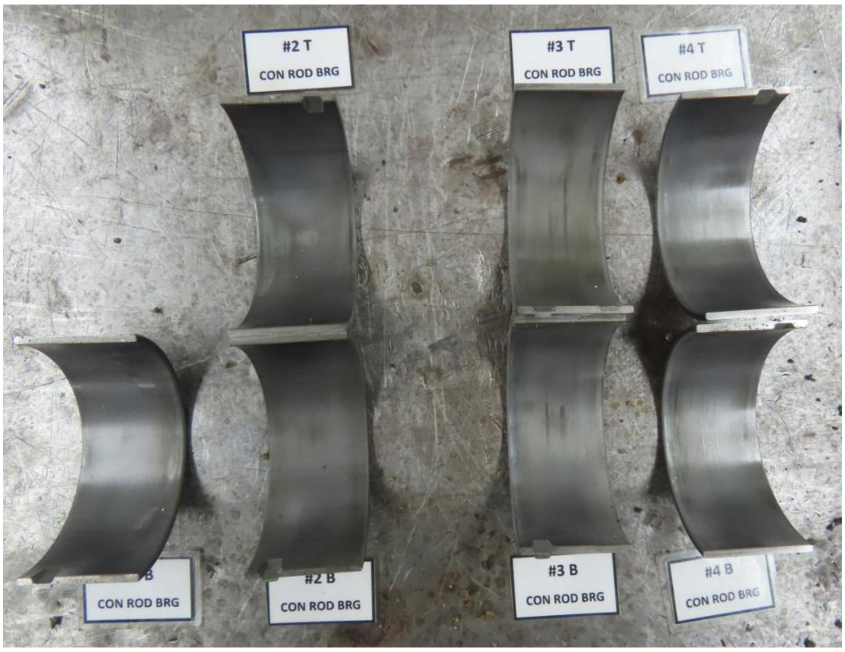


Figure 23: Bearings

- The crankshaft main bearings were examined and no lack or loss of lubrication conditions were observed. The surface of the available bearings were found unremarkable.

Based on examination of engine remnants, the ACCREP made the following observations:

a) Spark plugs appeared to have minimal wear, and exhibited signatures consistent with normal operation.

b) The piston heads were coated in light tan deposits consistent with normal combustion.

c) The crankshaft and camshaft journal surfaces were free of significant wear, and the cam shaft lobes were in good condition and displayed an appropriate lift.

d) There was no evidence of pre-accident catastrophic failure or lubricant exhaustion.

e) The carburetor appeared to be equipped with the solid, blue epoxy float as recommended by the manufacturer.

It was inferred from the engine strip examination that the engine was generating power at the time of accident.

1.16.2 Aircraft Control System Examination

The control cables and pulleys of all the control surfaces, retrieved from the wreckage, were examined at the AAIB by a DGCA-approved Aircraft Maintenance Engineer (AME) who holds a type rating on the aircraft. This examination aimed to assess their condition. The following are the observations made during the visual inspection of these components:

1.16.2.1 Initial Assessment of Control Cables and Pulleys (Visual inspection)

Right Rudder Cable

(i) At some points bend due to impact were observed.
(ii) Cable was found rusted near the fork end.
(iii) Fork-end along with the check-nut was also found rusted.
(iv) 7.5 inch cable was found rusted and strands were observed.
(v) Two bunches of strands were found broken.
(vi) Strands observed at other places also.

Left Rudder Cable

(i) At some points bends due to impact were observed.
(ii) Check-nut and fork end found rusted.
(iii) Towards fork end cable was found rusted.
(iv) Strands were observed due to rust.
(v) Other areas of cable were also found rusted.

Aileron (Left Wing)

(i) Cable was found bent at some places due to impact.
(ii) Strands were found near ball joint.
(iii) Other than few scratch marks, cable was found satisfactory.

Aileron 2nd Cable (left side fuselage)

No rust or strands was observed on the cable.

Aileron (Right Wing)

(i) Bolt of bell-crank was found rusted.
(ii) No lubrication was found inside the bolt.
(iii) Only at one place few strands were observed.
(iv) No rusting was observed on the cable and found satisfactory.

Aileron 2nd Cable (Right side fuselage)

(i) Cable was found bent at few points due to impact.
(ii) No rusting or loose strands were observed. Condition was found satisfactory.

Right Elevator

(i) Rust was observed at few places.
(ii) Strands were observed.
(iii) Approx. 1 feet of cable was found rusted towards fork end.
(iv) Anti-rust coating was not observed on the cable.

Left Elevator

(i) Turn buckle was found rusted.
(ii) No rust or strands was found on the cable.
(iii) Overall condition of the cable was found satisfactory.

Trim Tab Cable

(i) Trim Tab limit adjuster was found rusted.
(i) Trim chain was found lubricated or greased.
(ii) The condition of the Trim tab cable was satisfactory.
(iii) One cable was found replaced with the new one.

Right & Left Flap Cable

(i) Found rusted
(ii) Strands found
(iii) Flexibility found reduced
(iv) Turn buckle found satisfactory.

The observations made during visual inspection at AAIB particularly for Left Rudder Cable indicated at Lack of Preventive maintenance on the cables.

1.16.2.2 Detailed inspection of cables, pulleys, bearings and other associated components

After the initial visual inspection, a detailed inspection of all the cables, pulleys, bearings and other associated components was carried out using a magnifying glass. The observations outlined in the examination report is produced below:

Flaps & Aileron Pulleys

Total 06 small size pulleys were retrieved from the aircraft wreckage.

(i) Two pulleys were found completely broken and condition of other two pulleys found satisfactory.
(ii) Cable marks on the groove were not uniform.
(iii) Two pulley movement were not free as the bearing come out from recess.

Total 02 big size pulleys retrieved from the aircraft wreckage – Part No. not identifiable.

(i) Found broken
(ii) Movement not found free as the lack of lubrication was observed.
(iii) Self-locking nut were found rusted.

Rudder Pulley: Parts No. are not found on any pulley.

Total 04 pulleys were retrieved from the aircraft wreckage.

(i) One pulley was found cracked from the groove area.

(ii) One pulley contained rubbing marks on the grooves.
(iii) Two pulleys were found totally rusted.
(iv) No lubrication was observed on any pulley.
(v) Excess of play or clearance was found in all the 04 pulleys.

Trim Tab: Total 08 pulleys:

Part No: - Not found. [One pulley RALMARK P. No. – S -378-1]

(i) Four were found completely broken.
(ii) One was found damaged.
(iii) Four were found completely rusted and dry.

Rudder Horn: NIL OBSERVATION

Elevator Pulleys: (Total No: 10 + 02 = 12 pulleys)

RALMARK Part No. – S – 3784 (Total - 03)

(i) One pulley contained cable rubbing marks on the pulley groove.
(ii) Needle bearing came out from the recess due to impact.

RALMARK Part No: S-378-3L observed on two pulleys

Two pulley part No. were not readable

(i) One pulley was found damaged.
(ii) Rubbing marks observed on pulley grooves on 03 pulley.
(iii) Free movement found for all the 04 pulleys

Rubbing marks generated due to improper tension.

RALMARK Part No: S-378-3L observed on only one pulley.

(i) One pulley was found damaged.
(ii) One pulley was found satisfactory.
(iii) Rubbing marks observed on the broken pulley and they appear fresh.
(iv) Movement was found free.

RALMARK Part No: MS 202220-2 (Two pulleys)

Both found damaged due to impact

(i) Movement found free
(ii) Bearing found satisfactory

Elevator Trim Pulley:

(i) At one point recess found broken due to impact.
(ii) Uneven marks are found on the groove area.
(iii) Needle bearing movement was not smooth.
(iv) Rusting was found on bearing area and lack of lubrication may be the reason.

Detailed inspection showed that few components are corroded and strands of few cables are also broken reflecting improper maintenance during scheduled inspections.

Based on the results of initial visual inspection carried out by an AME, it was decided by the investigation team to get the components inspected by another agency to cross verify those findings. Hence, the control cables and their associated components were sent to a DGCA approved maintenance agency. The comprehensive examination report of the said agency is included in this report as Annexure B.

Detailed inspection showed that improper maintenance practices were being followed during scheduled inspections resulting into cable & pulley's bearing corrosion and broken cable strands beyond the serviceable limits.

1.17 Organizational and management information

Flytech Aviation Academy is a DGCA approved Flying Training Organisation imparting ab-initio flying training on light aircraft since September 1995. The FTO was earlier based in Nadirgul and shifted to the present location at Nagarjunasagar in the year 2020.

M/s FAA holds DGCA approvals under CAR Section 7 Series D Part 1 (FTO) CAR M Subpart F (AMO), CAR M Subpart G (CAMO), CAR 147 Basic (AME Basic Maintenance Training Organisation) and CAR Section 7 Series G Part V (AELP Training and Testing Organization).

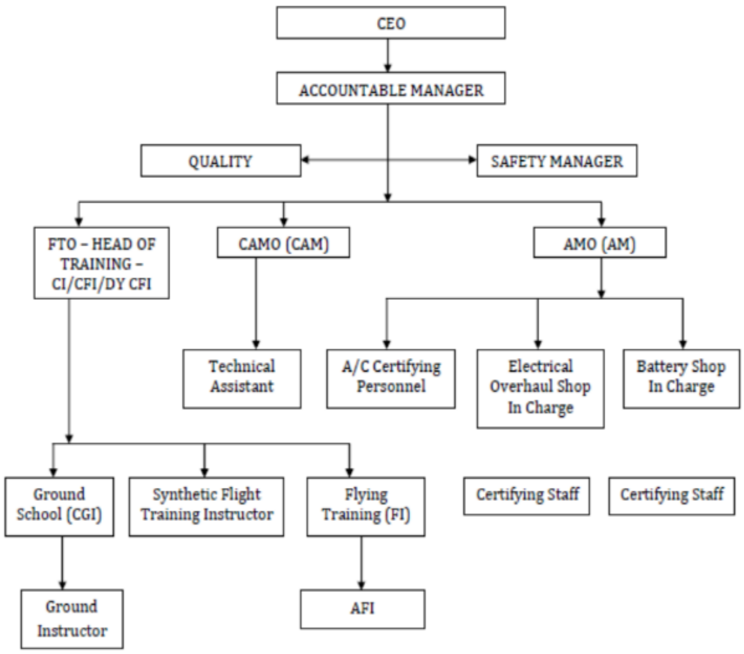


Figure 24: Organisation Chart

FTO, Flytech Aviation Academy imparts training for SPL, PPL, CPL, IR, AFIR, FIR, recency, renewal and conversion on light aircraft single engine and Simulator Training on Single Engine & Multi Engine. The approval of Flying Training Organization (FTO) was renewed by DGCA and was valid upto 17.11.2022. The organizational chart of the flying club is shown in the Figure 24.

FTO has Cessna aircraft in its fleet and the details of those aircraft is as below:

S. no	Aircraft Details	VT-FAS	VT-FAV	VT-FAL	VT-FAO	VT-FAM
a)	Type of A/C	C-172	C-152	C-152	C-152	C-152
b)	Registration No.	3962	3961	2759	2897	2895
c)	Owned/leased	Owned	Owned	Owned	Owned	Owned
d)	Date of Manufacture	2005	1980	1983	1979	1979

Except the one aircraft which was manufactured in 2005, all the other aircraft (including VT-FAO) owned by M/s FAA have been in service for the past 40 years.

1.17.1.1 TPM (Training Procedure Manual) of the Organisation

Company TPM states that it is the main guideline document of the organization contained policies and procedures to impart Flying Training and it is based on CAR Section 7 Series D Part 1 regulations and other related guidelines, regulations, circulars etc.

Company's Training Procedure Manual Issue 02 Rev 00 was issued in April 2021 after approval of DGCA.

A. Duties & Responsibilities

Chapter 2 Para 2.3 (b) of TPM has laid down 'Duties and Responsibilities' of **Quality Manager**.

As per this section of TPM, the QM works closely with the Operations & Maintenance divisions of Flytech to develop and implement the quality policies & procedures and reports directly to Accountable Manager. The quality Manager and the quality system work independent of the organization, and at no point does he involve directly into the routine operations of the FTO.

"Duties and responsibilities" of a QM employed with FAA defined in company manual are reproduced below:

> *"1) Implement the quality assurance system within the FTO, with the aim of achievement of results that conforms to the standards set out in the FTO's Manuals and in requirements and documents issued by the DGCA, thus promoting continual improvement of the quality of training provided.*
>
> *2) Monitor compliance of the CAR, associated regulations & DGCA requirements.*
>
> *3) Verify, by monitoring activities in the field of training, that the standards as established by the FTO and any additional requirements of the DGCA are being carried out properly.*
>
> *4) He/she is responsible for implementing the annual quality audit program in which compliance with all operational/maintenance procedures is reviewed at regular intervals (including the management and completion of audits and production of audit reports).*
>
> *5) He/she should ensure that any observed non-compliances or poor standards are brought to the attention of the person concerned via his/her manager.*
>
> *6) Responsible for follow up and closure of any non-conformances identified.*
>
> *7) Identify, through continuous monitoring, the human factors principles to be implemented within the organization*
>
> *8) Establish regular meetings with the Accountable Manager to appraise the effectiveness of the quality system. This will include details of any reported discrepancy not being adequately addressed by the relevant person or in respect of any disagreement concerning the nature of a discrepancy.*
>
> *9) Highlighting quality and safety concerns that might arise from the working practices of the FTO.*
>
> *10) Ensure that the quality assurance system is properly implemented, maintained and continuously reviewed and improved".*

Chapter 2 Para 2.3 (g) of TPM has laid down the guidelines on 'Duties and Responsibilities' of **Maintenance Manager** DGCA approved post holder.

As per the guidelines stipulated in FAA TPM, the Maintenance Manager is responsible for ensuring that all maintenance required to be carried out, plus any defect rectification carried out during aircraft maintenance, is carried out to the design and quality standards specified in CAR M. He is also responsible for any corrective action resulting from the M.A.616 organizational review or quality system audits, as the case may be for Flytech's Approved Maintenance Organization. Further, as per TPM, Maintenance Manager also reports to Accountable Manager.

'Duties and Responsibilities' stipulated in TPM for Maintenance Manager are reproduced below:

1) "He shall ensure that the maintenance procedures are established and implemented within the organisation, to accomplish the maintenance tasks to the standards of airworthiness and workmanship in accordance with CAR M / DGCA requirements.

2) He shall ensure that all maintenance is certified by the certifying staff/ approved/authorized persons and that records of maintenance are retained safely and securely for the statutory period.

3) He shall report any condition of the aircraft or a component, which could hazard the safety of aircraft, to the Owner/Operator through CAM, QM and AM.

4) On-the-job evaluation of Engineers and Technicians/Mechanics.

5) Competency assessment of Engineers and Technicians/Mechanics.

6) Implementing the safety and quality procedures defined by the Organization.

7) The Maintenance Manager shall duly undertake responsibility for certification of aircraft whenever required."

Chapter 2 Para 2.3 (h) of TPM clearly defines about the role & responsibilities a **CAM** has to perform and the requirements of CAM are defined under Continuing Airworthiness Management Exposition Part B. As per TPM, "*The Continuing Airworthiness Manager is a person responsible for ensuring that the continuing airworthiness tasks are performed and accomplished as per CAR M Sub Part C for the aircraft held by FAA. He shall also ensure that airworthiness review of aircraft, if applicable under organization scope, is done in time*". CAM Reports to the AM

Relevant section of Chapter 2 Para 2.3 (h) of the TPM is reproduced below:

"Duties & Responsibilities of CAM

Continuing Airworthiness Manager will ensure that all maintenance is carried out by suitably approved maintenance organization, in accordance with the relevant approved maintenance program, on Time, and to an approved standard. He will act to ensure that the organization's responsibilities in the following areas can be met:

1) Establishment and development of maintenance programmes for the aircraft managed by FAA as required by CAR M.

2) Presentation of maintenance programmes to the DGCA for approval.

3) Manage the approval of modifications and repairs.

4) Ensuring modifications and repairs (changes) are carried out to an approved standard.

5) Ensuring all maintenance is carried out in accordance with the approved maintenance programme and released in accordance with M.A. subpart H.

6) Ensuring all applicable AD's and operational directives with a continued airworthiness impact, are applied.

7) Ensuring the Coordination of scheduled maintenance, the application of AD's, the replacement of service life limited parts and component inspections to ensure work is carried out properly."

Chapter 3 Para 3.3 of TPM has again laid down the responsibility of different post holder employed with the organization regarding 'Serviceability of Aircraft' and the content from said Para is reproduced below:

"Serviceability of aircraft is ensured by CAM of the organization. He is responsible for maintaining the aircraft in airworthy condition as per approved AMP. He will issue timely work call out to AMO for carrying out required maintenance. MM of the AMO ensures the required maintenance is carried out and certifies the aircraft is fit to fly.

Quality Manager shall check during internal audits whether aircrafts and simulators are maintained as per the approved procedures. If any deviations are observed, he will be issuing noncompliance report for taking corrective and preventive action. Quality Manager ensures through verification audit that deviations are corrected."

B. Cross Country Training Flight

The operator, in its TPM Chapter 4 'Training Plan' Para 4.8.5 (B) and Para 4.8.5 (C), has defined about the requirements and procedures to be followed before student Pilot is release for first solo cross-country flight and sending the Trainee for Night Flying. The content of the both Para's are reproduced below:

"4.8.5. Requirements before first solo day/night / navigation (cross country)

B) Procedures for first solo cross-country/navigation

Solo Cross country will begin after completion of minimum of 10 hrs of local solo flying, 5 hrs of Instrument flying and 8 hrs of dual x-co instructions. (first 5 hrs of Cross country can be with AFI/FI and followed by a 3 hrs of Cross country check by CI/CFI/Dy.CFI /FI) and being satisfied with the following:

(1) The Pilot has adequate knowledge in air navigation & meteorology.
(2) The Pilot has to file a Flight Plan Online.
(3) Map Reading (To ensure that up to date maps are invariably provided on all cross country flights)
(4) Metrological Briefing.
(5) The Pilot has prepared a satisfactory operational NAVIGATION FLIGHT plan for the flight which shall include:-

a) Track to be made good
b) Cruising height;
c) Expected course;

d) Expected ground speed;
e) Check points enroute along with the respective ETAs.

(6) Load and Trim Sheet.
(7) Obtained ADC/FIC.
(8) Frequency for departure, enroute and arrival airport.
(9) Knowledge of GPS if on board.
(10) Lost procedure and force landing.
(11) Sufficient fuel and oil for the intend cross country for alternate aerodrome.
(12) Deviating from the track and low flying is strictly prohibited in cross country."

Chapter 9 Para 9.6.1 of TPM has stipulated the procedures and guidelines on "STANDARD OPERATING PROCEDURE (SOP) FOR CROSS-COUNTRY FLIGHTS – (DAY & NIGHT)". The content of Para 9.6.1 which has relevance to this investigation is provided below:

"*Flytech Aviation Academy conducts all cross-country flights-(day & night) as per the standard operating procedure (SOP) and contingency procedures issued by DGCA flying training circular 4/2020 dated 31 December 2020. Cross country flights (day and night) can be operated from a controlled or uncontrolled aerodrome.*

***Route Assessment:** Keeping in mind the terrain and obstructions (from publicly available information sources) all the cross-country routes are assessed. At least 1500 feet clearance must be provided above the highest obstacle on the route. All cross-country routes are selected carefully to avoid congested areas and water bodies and are to be reviewed annually.*

C. Points to be taken while choosing landing sites

***Landing sites purpose:**Cross-country routes are selected such that it causes minimum risk to people on ground and in the aircraft for executing a safe landing in case of engine failure.*

***Landing sites selection:** Based on the data available from topographical information and area maps, landing sites have been selected. In addition, it must also be of adequate length and width to stop the aircraft in case of any emergency.*

***Landing sites identification during flight:** The coordinates, track and distance of landing sites are identified for each route and are a part of the navigation log. They are plotted on the map so that the information of landing site is immediately available.*

***Period of risk:** Risk period is the time in air for an airplane when there is no landing site available within the gliding range. It has been ensured that the risk period is not more than 15 minutes on all landing sites and routes. Should the engine fail on a single engine aircraft during the risk period then a suitable landing field is to be selected for a forced landing.*

***Forced landing procedure on landing sites:** When all engine restart procedures fail, forced landing is imminent, select the nearest landing site. Initiate a forced landing into the wind as far as possible. Declare MAYDAY on current radio frequency which is maintained, squawk 7700 and activate ELT before completing force landing.*

D. Pre-flight requirements

Weather and NOTAMS: *Applicable NOTAMS, TAF (aerodrome forecast) for en-routes and alternate aerodromes are to be obtained before flight.*

Briefing: *Trainee pilots are to be briefed with the above SOP by their flight instructors before flight.*

Radio communication: *Continuous two-way communication is to be maintained with the ATC.*

Maps and Charts: **Chapter 5 Para 5.11** of TPM contains guidelines on 'Maps and Charts'. As per this section of TPM, during flight planning, it must be ensured that all maps and charts are carried onboard and following procedures are required to be adhered by student pilots:

1. *All pilots should ensure that they are carrying current and suitable maps and charts for every flight.*
2. *All pilots planning for a cross-country shall carry a chart covering a radius of 150 nms for the departure/destination and alternate aerodrome.*
3. *All maps/charts carried on board should be clear.*
4. *All pilots should have adequate knowledge on map reading and en-route charts.*
5. *Instructors' should ensure that trainee should be briefed on map reading for a new route.*
6. *Other than normal navigation map in the aircraft a standby should be available.*
7. *Pilots should carry both Jeppsen operational navigational charts and topographical charts for the cross country.*

Carriage of maps and charts become essential mostly to navigate. Under normal conditions we read from map to ground. When uncertain of position or lost, read from ground to map until position is established.

E. Regulations on Aircraft Fueling

Chapter 5 Para 5.14 states about flight planning procedure to ensure carriage of proper fuel onboard. The content of the said Para is reproduced below:

It's the pilots' responsibility to carry sufficient fuel to ensure that it can safely complete the flight. A reserve shall be carried to provide contingencies and to enable the a/c reach alternate aerodrome.

For all the local sorties total fuel for Sortie Time @ 20lts / hr for 152 and 30lts / hr for 172 plus 40 lts of fuel as reserve.

F. TPM Annexure and FOB

The Annexure ‘29’ of the TPM “ROUTES FOR DAY/NIGHT CROSS-COUNTRY FLIGHTS” has depicted the route aircraft has to follow if flying towards Raichur. On the route map, location along with site coordinates to execute emergency landing are also provided so that during flight if any emergency situations arises then crew can plan for emergency landing at the sites.

Figure 25: Raichur Route

VONS (261brg/115 nm)-RAICHUR (081brg/115 nm)-VONS

Following are the landing areas in case of emergency:

1.	5nm – 16’31.7’N 79’ 13.6’E	13.	65nm –16’20.8’N 78’ 12.3’E
2.	10nm –16’31.6’N 79’ 8.E	14.	70nm – 16’19.9’N 78’ 7.2’E
3.	15nm –16’29.8’N 79’ 31.1E	15.	75nm –16’19’N 78’ 2.0’E
4.	20nm –16’28.8’N 78’ 58.4’E	16.	80nm –16’18.1’N 77’57’E
5.	25nm –16’27.8’N 78’ 52.9’E	17.	85nm –16’17.2’N 77’32’E
6.	30nm –16’26.9’N 78’ 47.7’E	18.	90nm –16’16.2’N 77’46.8’E
7.	35nm –16’26.2’N 78’ 43’E	19.	95nm –16’15.3’N 77’41.6’E
8.	40nm –16’25.1’N 78’ 37.7’E	20.	100nm –16’14.5’N 77’36.2’E
9.	45nm –16’24.4’N 78’ 32.7’E	21.	105nm –16’13.6’N 77’30.7’E
10.	50nm –16’23.8’N 78’ 22.4’E	22.	110nm –16’12.8’N 77’26.2’E
11.	55nm –16’22.5’N 78’ 22.1’E	23.	115nm –16’11.9’N 77’21.4’E
12.	60nm –16’22’N 78’ 17.3’E		

As per FOB, following routes have been selected by the organiastion for cross country sectors and they are shown on google map (Please refer Figure 35).

1. VONS-BHARDRACHALAM- VONS
2. BADRACHALAM - VOHY
3. VONS-KAVALI-VONS
4. VONS-CUMBUM-VONS
5. VONS-MARKAPUR-VONS
6. **VONS-RAICHUR-VONS**
7. VONS-TADEPALLIGUDEM-VONS
8. VONS-ADONI-VONS
9. VONS-VIJAYAWADA-VONS
10. VONS-RAJHAMUNDRY-VONS
11. VONS-GUNTUR-VONS
12. VONS-NELLORE-VONS
13. VONS-DHONE-VONS
14. VONS-NAKREKAL-VOHY-NDGL
15. NDGL-VOHY-SULAPETH-GGB-VOHY-NDGL
16. VONS-KANIGIRI-VONS
17. NDGL-VOHY-SURYAPET (abeam) -WIRALAKE - THIRUVIRU – VONS
18. VONS-VOCP-VONS
19. VONS-MACHILIPATNAM-VON
20. GGB-SOLAPUR
21. VONS-KODUMURU-VONS

As per the FOB of the organization, Chapter 3 Para 3.11 'Flying over the Water', it is strictly prohibited to fly over large water bodies in case of emergency situations.

1.18 Additional Information

1.18.1 Serviceability of aircraft instruments

While collecting evidences at the crash site, the mobile phone (iPhone) which was carried onboard by student pilot during the cross-country training flight was found damaged by the investigation team. After the accident, the personal iPad of student pilot said to be in custody of Flying training academy was handed over to a family member of deceased pilot. As both the devices (iPad & iPhone) were in sync therefore the photographs stored on the iPhone were also accessible on iPad which was not carried by the student pilot in the said training flight.

Figure 26: Attitude Indicator and Suction Gauge

The iPad was locked, however, the family member of student pilot was able to access the stored data, and photos from the iPad were provided to the Investigation team. One of the photographs obtained from the iPad showing the attitude indicator, directional indicator and suction gauge is shown in the Figure 26. The date and time of photograph was verified through properties and it was found that photograph was taken on the day of accident, 26 Feb 2022 at 10:29 IST (0459 UTC). This implies that the photograph was clicked once the aircraft took off from Nagarjunasagar airfield. (As per flight plan, takeoff time from Nagarjunasagar airfield was 0456 UTC).

1.18.2 Control Cables Inspection

The OEM has provided comprehensive guidelines for the inspection procedures of the Control Cable System including pulleys in aircraft's AFM. This document is continuously updated based on industry feedback and the analysis of data gathered by the OEM from around the world. The last revision, Temporary Revision Number 5, was issued on 1 Dec 2011. This revision has stipulated the guidelines for inspection or maintenance of control cables and its associated components based on the environmental conditions in which the aircraft is operating:

The following are the reasons cited by the OEM for introducing Temporary Revision Number 5:

1. To add the Supplemental Inspection Documents (SIDs) Information.
2. To add the Corrosion Prevention and Control Program (CPCP) Information.
3. To add Control Cable Inspection Information.

The guidelines for conducting the inspection of control cables and pulleys, in accordance with Temporary Revision 5, are outlined as follows:

Inspection of Cable System

(1) Routing

(a) Examine cable runs for incorrect routing, fraying and twisting. Look for interference with adjacent structure, equipment, wiring, plumbing and other controls.

(b) Check cable movement for binding and full travel. Observe cables for slack when moving the corresponding controls.

(2) Cable Fittings

(a) Check swaged fitting reference marks for an indication of cable slippage within the fitting. Inspect the fitting for distortion, cracks and broken wires at the fitting.

(b) Check turnbuckles for proper thread exposure. Also, check turnbuckle locking clip or safety wire.

(3) Inspection of Control Cable

(a) *The control cable assemblies are subjected to a variety of environmental conditions and forms of deterioration that ultimately may be easy to recognize as wire/strand breakage or the not-so-readily visible types of corrosion and/or distortion. The following data will aid in detecting an unserviceable cable condition:*

(b) Broken Wire: *Examine cables for broken wires by passing a cloth along the length of the cable. This will detect broken wires, if the cloth snags on the cable. Critical areas for wire breakage are those sections of the cable which pass through fairleads, across rub blocks and around pulleys. If no snags are found, then no further inspection is required. If snags are found or broken wires are suspected, then a more detailed inspection is necessary, which requires that the cable be bent in a loop to confirm the broken wires. Refer to Figure 27 for an example. Loosen or remove the cable to allow it to be bent in a loop as shown. While rotating cable, inspect the bent area for broken wires.*

Wire breakage criteria for the cables in the flap, aileron, rudder and elevator systems are as follows: Individual broken wires are acceptable in primary and secondary control cables at random locations when there are no more than three broken wires in any given 10-inch (0.254 m) cable length.

(4) Corrosion

a) Carefully examine any cable for corrosion that has a broken wire in a section not in contact with wear producing airframe components, such as pulleys, fairleads, rub blocks etc. It may be necessary to remove and bend the cable to properly inspect it for internal strand corrosion, as this condition is usually not evident on the outer surface of the cable. Replace cable if internal corrosion is found.

b) Areas conducive to cable corrosion are below the refreshment center, in the wheel well and in the tailcone. Also, if a cable has been wiped clean of its corrosion preventative lubricant and metal-brightened, the cable must be examined closely for corrosion.

(4) Pulleys

(a) Inspection of Pulleys

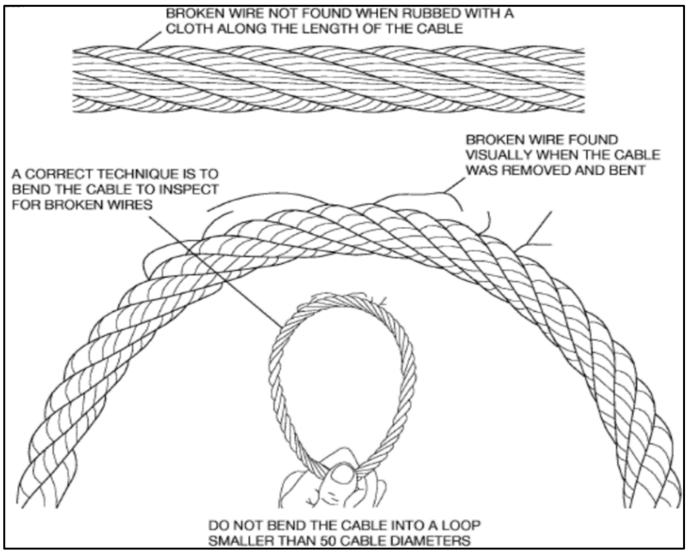


Figure 27: Check for Cable Broken Wires

1. Inspect pulleys for roughness, sharp edges and presence of foreign material embedded in the grooves. Examine pulley bushings or bearings to ensure smooth rotation, freedom from flat spots and foreign material.

2. Periodically rotate pulleys, which turn through a small arc, to provide a new bearing surface for the cable.

3. Check pulley alignment. Check pulley brackets and guards for damage, alignment and security. Various failures of the cable system may be detected by analyzing pulley conditions. Refer to Figure 28 for pulley wear patterns; these include such discrepancies as too much tension, misalignment, pulley bearing problems and size mismatch between cable and pulley.

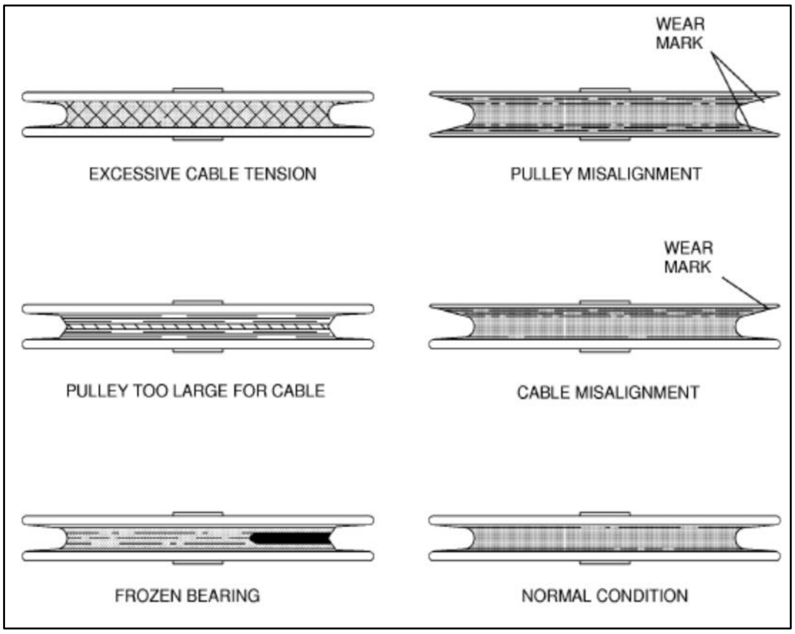


Figure 28: Check for Pulley Wear Patterns

(5) Cable Storage: *Cable assemblies shall be stored straight or in a coil. When stored in coil form, the coil inside diameter shall not be less than 150 times the cable diameter or bent in a radius of not less than 75 times the cable diameter. Coils shall not be flattened, twisted or folded during storage. Storage requirements shall apply until the cable is installed in its normal position in the airplane. If only a part of the cable is installed in an assembly, cable storage requirements apply to the uninstalled portion of the cable.*

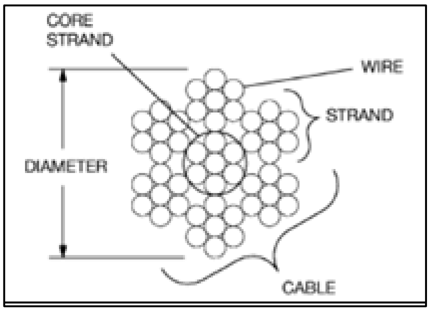


Figure 29: Cross section of cable

(6) Flight Control Cable Inspection

(a) General Information

WARNING: If the flight control cable system(s) are removed, disconnected or cable section(s) are replaced, make sure that all rigging, travel checks, cable tensions and control surface checks are done in accordance with the procedures in the appropriate section for the affected flight control system.

NOTE: *Flight control cable inspections are normally performed without removing or disconnecting any part of the flight control system. However, it may be necessary to derig or remove the cable to get access to the entire cable.*

(b) Cable Inspection Procedure

1. Each flight control cable must be visually inspected along its entire length for evidence of broken wires, corrosion, fraying or other damage. Visual inspection may be via direct sight, mirror and flashlight or borescope.

2. Visually check for proper routing along entire length of cable. Make sure that cables, pulleys, attaching sectors and bell cranks are free and clear of structure and other components

NOTE: *Some systems use rub blocks, it is permissible for control cables to rub against these blocks.*

3. Each flight control cable will be physically inspected, by passing a cloth along the entire cable. Pay particular attention at all pulley, fairlead, bulkhead seal locations and other locations where the cable may be subject to chafing or wear.

NOTE: *It may be necessary to have a second person move the flight control system being inspected to ensure that the entire cable run in an affected area is checked.*

4. Any flight control cable which snags the cloth due to broken wires is to be slackened (if not previously slackened) and a loop test performed to identify number and location of individual broken wires (refer to Inspection of Control Cable). Wire breakage criteria is as follows for all cable systems:

a) Individual broken wires are acceptable in any cable provided that no more than three individual wires are broken in any given ten-inch (0.254 m) cable length. If number of individual broken wires cannot be determined, cable is to be rejected. Any amount of cable or wire wear is acceptable, provided the individual broken wire criteria is met.

b) Reject any cable if corrosion is found which appears to have penetrated into interior of cable. If extent of corrosion cannot be determined, cable is to be rejected.

5. Inspect all cable termination fittings (clevises, turnbuckles, anchors, swagged balls etc.) for security of installation, proper hardware and evidence of damage.

a) All turnbuckles are required to be secured. Safety wire or prefabricated clips are acceptable.

6. Inspect cable pulleys.

a) Inspect all pulleys for security of installation, evidence of damage and freedom of rotation.

b) Pulleys which do not rotate with normal cable movement due to internal bearing failure are to be rejected.

c) Pulleys with grooving etc., due to normal in-service use, are deemed serviceable, as long as overall function is not impaired.

7. Restore cable system as required following cable teardown (if performed).

a) Tension tasks and other tasks specific to individual systems are described under applicable individual tasks.

b) Any flight control cable system which has been torn down requires a flight control rigging check prior to release of airplane for flight.

Expanded maintenance and CPCP program given in the AFM is placed at Annexure 'C'.

The Annual Maintenance Program of the FTO was approved by DGCA on 23.11.2020.

As per the Aircraft Maintenance Program (AMP), difference between inspection's frequencies required to be carried out on an aircraft in respect of mild/moderate Corrosion environment and Severe Corrosion environment are as given below:

S. No.	Inspection details	Mild/moderate Corrosion environment	Severe Corrosion environment
1.	Inspect main landing gear tubular spring for rust or damage to finish. Inspect entry step attachment. Refer to Section 2A-14-03, Supplemental Inspection Document 32-13-01, for inspection procedure.	Initial: 20 Years; Repeat: 10 Years	Initial: 10 Years; Repeat: 5 Years
2.	Inspect carry-thru spar area, wing attach fittings, spar channel and lugs. Refer to Section 2A-14-06, Supplemental Inspection Document 53-11-01, for inspection procedure.	Initial: 20 Years; Repeat: 10 Years	Initial: 10 Years; Repeat: 5 Years
3.	Inspect the cabin interior skin panels, frames and stringers. Refer to Section 2A-14-07, Supplemental Inspection Document 53-30-01, for inspection procedure.	Initial: 20 Years; Repeat: 10 Years	Initial: 10 Years; Repeat: 5 Years
4.	Inspect seat rails for corrosion. Refer to Section 2A-14-08, Supplemental Inspection Document 53-47-01, for inspection procedure.	Initial: 10 Years; Repeat: 10 Years	Initial: 5 Years; Repeat: 5 Years
5.	1. Inspect inboard wing structure and wing attachment to fuselage including working rivets. 2. Inspect flap actuator support structure. Refer to Section 2A-14-14, Supplemental Inspection Document 57-11-01, for inspection procedure.	Initial: 12,000 hours or 20 years; repeat: 2,000 hours or 10 years	Initial: 6,000 hours or 10 years; repeat: 1,000 hours or 5 years
6.	Inspect wing for corrosion and missing or loose fasteners. Refer to Section 2A-14-15, Supplemental Inspection Document 57-11-02, for inspection procedure.	Initial: 20 Years; Repeat: 10 Years	Initial: 10 Years; Repeat: 5 Years
7.	Inspect wing splice joint at strut attach. Refer to Section 2A-14-16, Supplemental Inspection Document 57-11-03, for inspection procedure.	Initial: 20 Years; Repeat: 10 Years	Initial: 10 Years; Repeat: 5 Years
8.	Inspect wing root rib. Refer to Section 2A-14-17, Supplemental Inspection Document 57-12-01, for inspection procedure.	Initial: 5 Years; Repeat: 5 Years	Initial: 3 Years; Repeat: 3 Years
9.	Inspect wing strut and strut tube. Refer to Section 2A-14-18, Supplemental Inspection Document 57-40-01, for inspection procedure.	Initial: 12,000 hours or 20 years; repeat: 2,000 hours or 10 years	Initial: 6,000 hours or 10 years; repeat: 1,000 hours or 5 years
10.	Inspect flap tracks for corrosion. Refer to Section 2A-14-20, Supplemental Inspection Document 57-53-01, for inspection procedure.	Initial: 20 Years; Repeat: 10 Years	Initial: 10 Years; Repeat: 5 Years

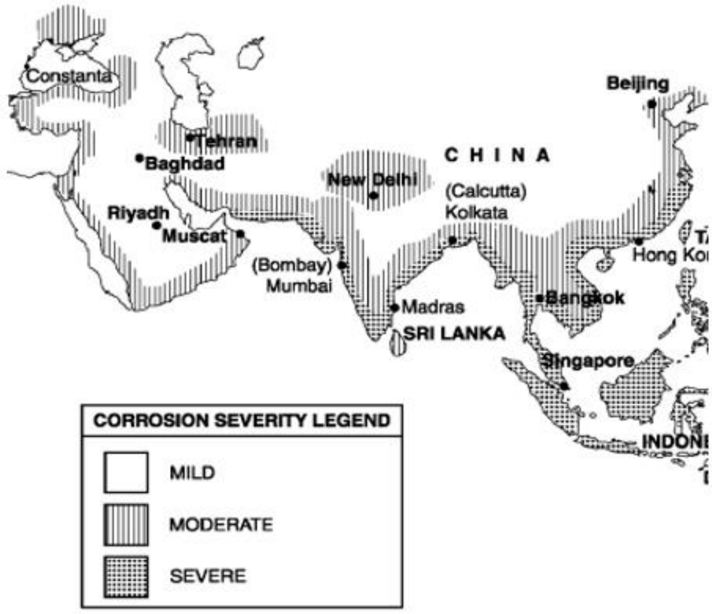


Figure 30: Asia Corrosion Severity Map

Based on the aforementioned data, it can be deduced that the frequency of inspections is doubled when dealing with severe corrosion environments, in contrast to inspections conducted in mild or moderate corrosion environments.

The location of the Flying club is in Mild Corrosion Severity zone, however, majority of its operations are carried out in the Severe corrosion zone as can be seen from the Corrosion Severity Map of the region provided in the AFM (Cross Country routes selected by operator are shown in Figure 35).

1.18.3 Radar Information

The Radar data provided by AAI, Hyderabad station, which cleared the aircraft for cross country flight, was analysed to know the aircraft status at different locations and the route followed during the flight. The aircraft was captured on Hyderabad Radar only after back course was set by the student pilot. As the aircraft started moving towards north and gained some height, it came in contact with Hyderabad Radar. The following is observed about the aircraft before it disappeared from the screen:

The route segment flown by VT-FAO is classified as Class-G airspace.

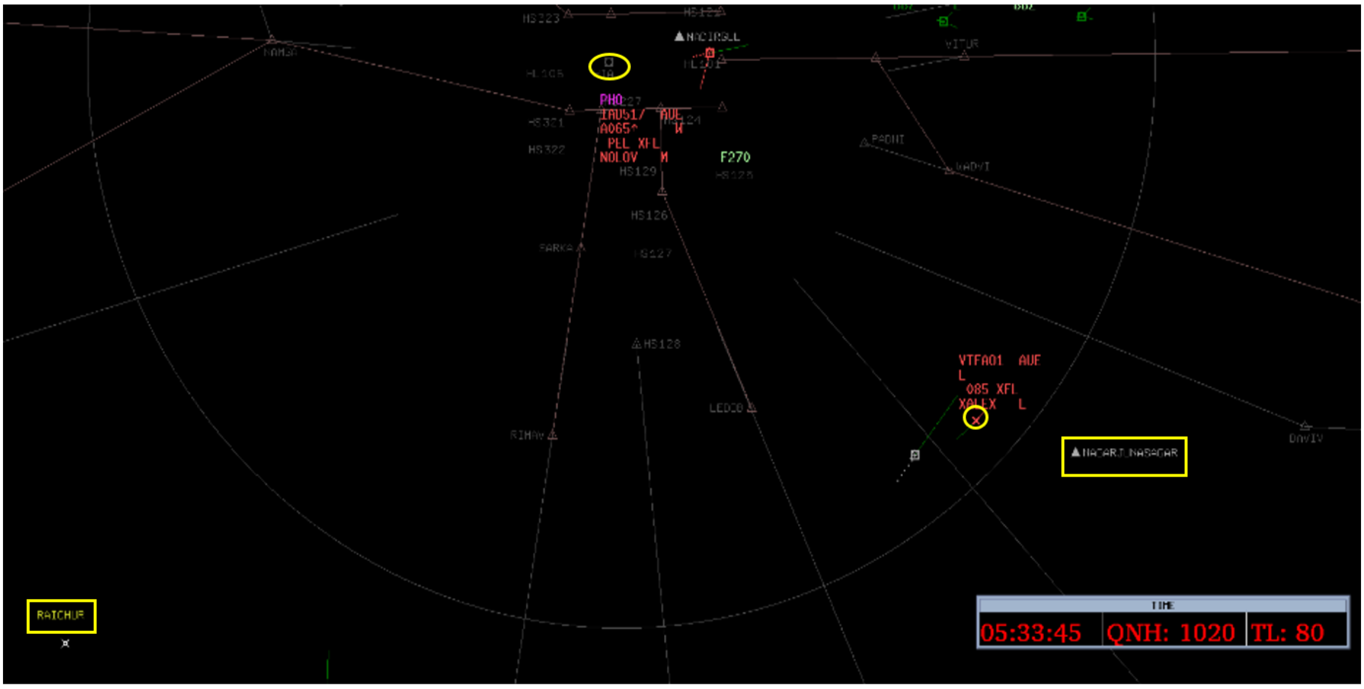


Figure 31: Aircraft first appeared on Radar Screen

As per the Radar Snapshot, the first RPS (radar position symbol) corresponding to VTFAO aircraft was observed on Radar at time 05:33:45 UTC on a bearing 298 and 10.8 Nm from Nagarjunasagar ith no Mode-C information. After a while the RPS was dropped (Refer Fig No. 27 & Fig No. 28).

Aircraft reappeared on radar screen at time 05:36 UTC but its flight level continuously kept fluctuating between 3700 feet to 3200 feet AMSL. The last flight level captured was FL34 and thereafter aircraft disappeared from Radar screen at time 05:40:59 UTC. At that time the RPS was observed on a bearing of 329 and 10.7 Nm from Nagarjunasagar with no Mode-C information.

Figure 32: Aircraft disappeared from Radar Screen

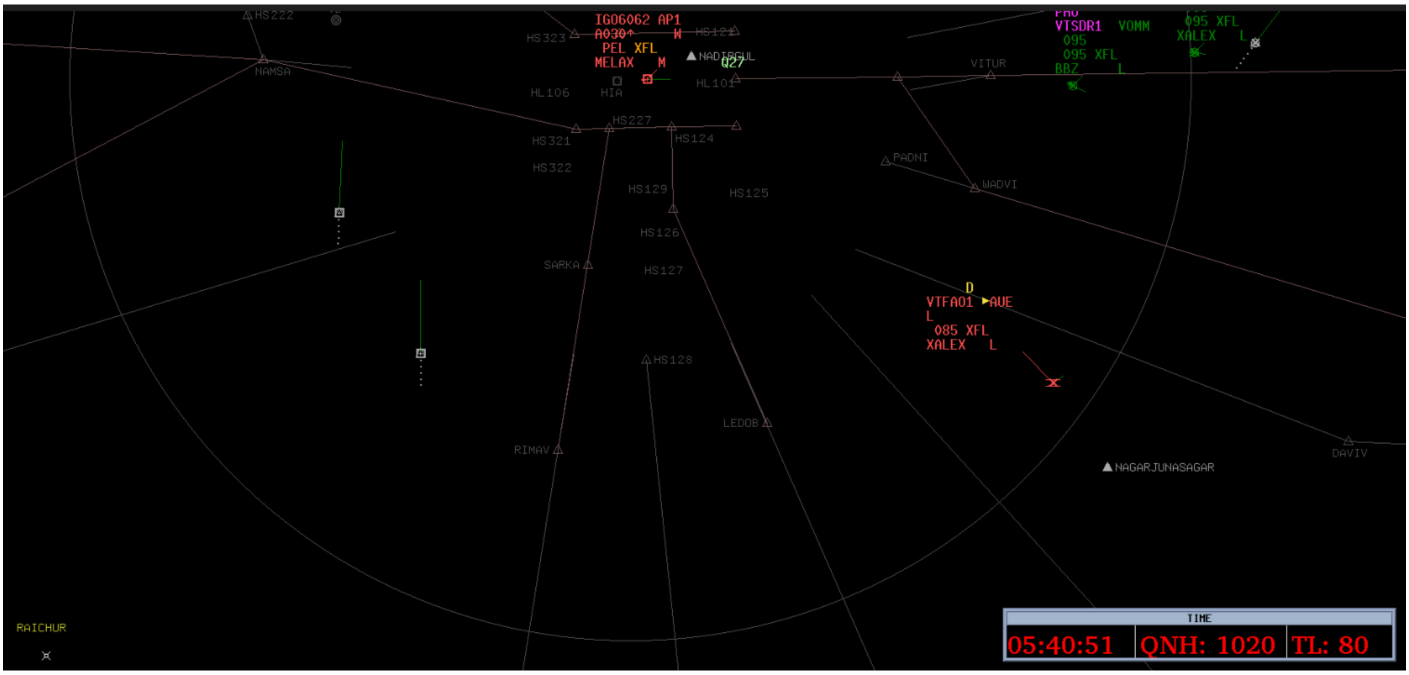


Figure 33: Aircraft last position captured by Radar

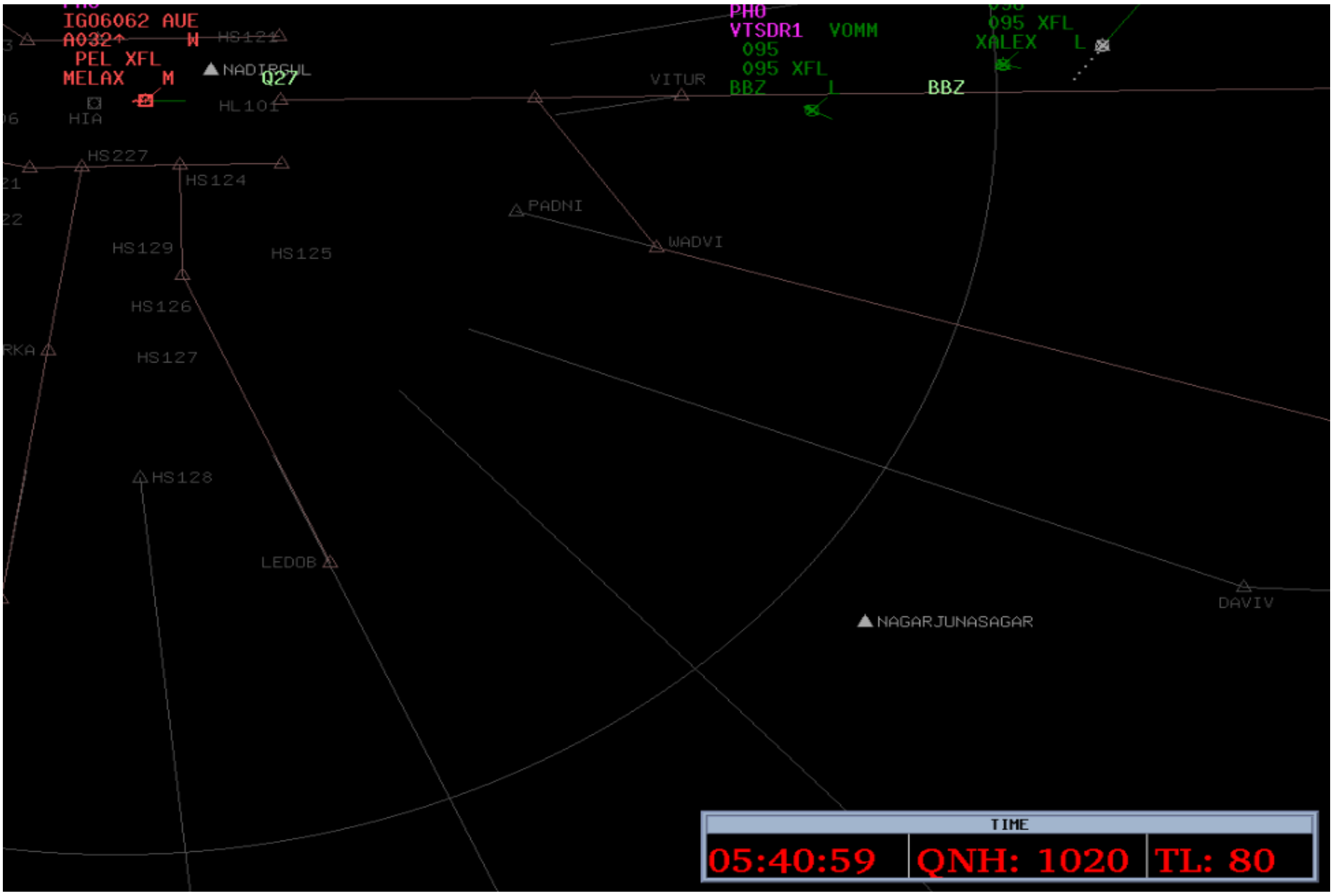


Figure 34: Aircraft disappeared from the Radar Screen

1.18.4 Radio Failure

The procedure laid down in TPM in case a pilot encounters any radio failure is as follows:

8.1 Pilots are to be familiar with the radio failure procedures. In most cases radio problems are more likely to be induced by the operator.

In the event of a suspected radio failure the following shall be checked:

*a) Ensure that the correct frequency has been selected and that volume control is correctly set. **Check radio and intercom ON***

b) If a second radio is available try that radio.

c) If a second headset is available try that headset, or switch the radio from 'Headset, to 'Speaker'.

8.2 Pilots experiencing a total radio (communications) failure are to squawk 7600 and return to base or divert and land at the nearest suitable airfield. Pilots shall expect and comply with light signals.

1.18.5 Past Recommendations by AAIB on VHF Communication

All FTOs operating from uncontrolled airfield maintain VHF set for communicating with their aircraft and ATCs in their vicinity. Unlike controlled airfield where the ATC communications are recorded and preserved for a certain period, the communications carried by VHF stations maintained by FTOs are not mandated to be recorded and preserved by the prevailing regulations.

This has posed problems during Investigation of accidents and incidents that occur during Flying Training Operations, as means to corroborate statement of personnel manning ATCs is not available in case of any discrepancy or conflicting evidences. Further, this will also enhance the supervision of flying training activities.

Faced with such issues, AAIB has issued recommendation for DGCA to mandate FTOs to create infrastructure for recording with necessary storage and retrieval facility in earlier Investigation Reports.

The recommendations from the previous two accidents are quoted below:

ACCIDENT INVOLVING CESSNA 172 R AIRCRAFT VT-CAF OPERATED BY M/S CHIMES AVIATION ACADEMY AT DHANA ON 03 JANUARY 2020

Safety Recommendation 4.2: Apart from statements from personnel manning ATC, there is no evidence of positive RT communication. Due to unavailability of RT recordings investigation team could not recreate exact timelines of various events. DGCA should issue CAR/Circular mandating FTOs to have infrastructure for recording RT communication with necessary storage and retrieval facility.

ACCIDENT INVOLVING TECNAM P2008JC AIRCRAFT VT-RBE OPERATED BY M/S REDBIRD FLIGHT TRAINING ACADEMY AT BARAMATI ON 20 SEPTEMBER 2021

Safety Recommendation 4.1: It is recommended that DGCA should mandate that all approved FTOs should have infrastructure for recording RT communication with necessary storage and retrieval facility.

1.19 Useful or effective Investigation Techniques

Nil

2. ANALYSIS

2.1 Serviceability of Aircraft

The aircraft had a valid C of A and the last ARC was issued on 21 Jan 2022. ARC was issued after necessary compliances were produced to DGCA. Scrutiny of Log books revealed that as on 26th Feb 2022, both aircraft and engine had completed 21123:31 Hrs (TSN) and 488:55 hrs respectively since last overhaul. The last inspection Operation 3 was carried out at 21122:01 Hrs on 25.02.2022. Thereafter, aircraft had flown 01:30 hrs, before it met with an accident on 26.02.2022.

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 Engine

The evidence from the wreckage examination indicate that the engine was generating power when the aircraft hit the ground. The engine was destroyed in the accident. The strip examination at OEM facility did not reveal any anomaly that could have caused degraded performance.

Maintenance of Aircraft Control Systems

As per records maintained by Engineering department, during scheduled inspections including Operation 9 and Operation 24 which exhaustively covers about the inspection procedures of control surfaces and its components, no discrepancies were ever raised during said inspections.

As per the Inspection Schedules, during said inspections, operator had followed all the procedures and task was performed as per work order. However, Investigation Team observed the following deficiencies in maintenance:

1. Review of Inspection Sheet revealed that cable tension and travel was not checked during those inspections.
2. By the virtue of the design, no procedure has been prescribed by the OEM for measuring tension of rudder cable. However, the same was recorded in the Inspection Sheet as being measured.
3. Post-accident examination of control cables revealed that the condition of few cables and pulleys were beyond the limits. Corrosion was found on control cable strands as well as on pulley bearings. Further, uneven marks were also found on groove area of pulleys indicating that the cable tension was not proper.
4. Although, majority of flight routes being used by the FTO falls in “Severe Corrosion Zone”, the maintenance prescribed in the DGCA approved AMP was as per the “Moderate Corrosion Zone”. Hence, adequate level of maintenance as per the CPCP was not being carried out on the aircraft.

This reflects poor maintenance practices being followed by the organization. While the records maintained by technical department show that all the maintenance activities or inspections were carried out as and when due as per laid down standards, however, the physical condition of those items does not corroborate the same.

Aircraft Instrument Panel

The Investigation team could not locate any instrument at crash site as the cockpit of the aircraft was totally destroyed in the accident due to high energy impact with ground. However, the photograph taken by the trainee pilot immediately after take-off clearly indicates that the suction gauge was showing nil reading though the aircraft was in power, indicating that it was faulty at the time of flight. Therefore, it is possible that the Attitude Indicator along with Directional Indicator might not have shown the correct readings.

The Attitude Indicator in the picture shows the aircraft in bank condition. Banking the aircraft would require pilot to have both hands on the controls. It is not possible for a pilot to take a picture of the Attitude Indicator while simultaneously flying the aircraft in banked condition. The attitude indicator was therefore faulty and was the reason for student pilot to take the photograph during flight.

Investigation team however, did not find any entries in the Defect Register pertaining to these unserviceable instruments.

Tyre

Tyre grooves were found worn out beyond the limits. This is also indicative of poor maintenance culture in the organization.

Techlog

Pilot name, sector, aircraft acceptance and departure time were not filled in the relevant column of the Tech Log.

It can be concluded that the Aircraft was not maintained as per the OEM guidelines and laid down regulations were not adhered to, during checks, inspections and Pre-flight inspections. Therefore, serviceability of the aircraft as a factor leading to accident cannot be ruled out.

2.2 Weather

On the day of accident, four company aircraft were released for flying from Nagarjuna Sagar airfield once it was established by ATC that local weather is conducive for training flights. However, no weather information was found recorded in the Met register maintained by training organization neither for Nagarjunasagar airfield nor for the sectors being designated for Cross Country flights.

As per the statement of ATC personnel, Student Pilot had never reported any adverse weather neither *enroute* to Raichur nor after requesting ATC to setting course back. Furthermore, student pilots who were flying in other sectors also did not report any adverse weather in the vicinity of Nagarjuna Sagar airfield during their training flights.

In absence of meteorological records being maintained by training organization particularly for the day of accident, investigation team took the assistance of IMD to provide weather information. As per the Radar images shared by Meteorological Department, no adverse weather was perceived at the time of accident.

Therefore, it is concluded that weather was not a contributory factor to the accident.

2.3 Crew Aspect

The Student Pilot issued with an SPL met all the prerequisite requirements, including the medical to operate a solo cross-country flight. The Student Pilot was never involved in any incident prior to the accident flight and had a total flying experience of 83:50 hrs on type including 30 hrs as PIC.

Based on the scrutiny of Student Pilot's FTPR, it is apparent that student pilot was well-acquainted with the aircraft systems and had received sufficient training to effectively manage emergency situations, which had been thoroughly practiced during training flights.

Furthermore, the Flight Training Progress Report (FTPR) also indicated that the Student Pilot had been making steady progress. No significant adverse remarks were noted, both in terms of aircraft handling and the skills required to operate an aircraft. Additionally, the Student Pilot had already covered all the necessary topics to take appropriate actions to address any unusual situations that might arise during the flight.

While returning to base (Nagarjunasagar airfield), the decision of the Student Pilot to initiate a diversion, avoiding the dam area and heading north, demonstrates that the actions taken by the Student Pilot were in accordance with the procedures/requirements outlined in the company's TPM or FOB:

1. Avoided overflying Nagarjunasagar reservoir even direct approach for runway 09 was possible but as per TPM overflying water reservoir during emergency is strictly prohibited.
2. Avoided an area of 3 Nm north of Nagarjunasagar Dam as the accident site was 10 Nm north of Dam.
3. After setting course back, sector south was avoided because that is not suitable for emergency landing as per TPM/FOB due to presence of high terrain in southern area.

As per the statements and records provided by ATC Hyderabad, neither any distress call was given to local ATC or Hyderabad ATC nor squawk 7600 was activated. The actions of the Student Pilots were in line with the actions required during an emergency and it is unlikely that an experienced student pilot would not have communicated the emergency to local ATC while informing intentions to return back. Due to lack of facility for recording VHF communications at FTO, the investigation team was unable to establish if student pilot had communicated reasons for return to the FTO.

2.4 Organisation Aspect

2.4.1 Duties and Responsibilities of Post Holders

The duties and responsibilities of post holders employed in the organization namely Quality Manager, Continued Airworthiness Manager and AME who holds the post of Maintenance Manager are well defined.

After the accident, following shortfalls have been noticed about aircraft maintenance and documents being maintained at their base:

a) Log book entries were not found dully filled

b) According to the pre-flight inspection conducted on the aircraft on the day of the accident, all aircraft systems and instrument components were found in serviceable condition. However, a photograph taken by the Trainee Pilot during the accident flight indicates that the Attitude indicator was unserviceable.

c) The Operation Schedules of last 02 years regarding the inspection of the aircraft control system were followed complied on aircraft. However, physical inspection of the wreckage showed that few control cables and pulleys exceeded the standard limits.

d) Corrosion was observed on few control cables including one turnbuckle indicating lack of proper maintenance activities on those components.

e) The daily top-up quantity of engine oil recorded in the Tech log did not match the aircraft's hourly oil consumption.

f) The AMP was not prepared in accordance with the guidelines provided by the OEM to carry out inspections and maintenance of control cables and associated components.

From above facts, it can be established that inspections or maintenance activities carried out on the aircraft and its system were not followed as per laid down standards. The overall supervision necessary to meet these standards was also lacking. This indicates that during the annual quality audit program, the Quality Manager failed to ensure the quality of procedures and overlooked the implementation of the quality assurance system within the organization. Furthermore, it appears that the individual authorized by the Quality Manager to conduct maintenance activities did not comply with the established standards.

The Maintenance Manager of the organization (AME) is assigned with the responsibility to ensure that aircraft are always maintained in airworthy condition and all maintenance activities being performed on aircraft meet the standards specified in CAR M. However, aircraft wreckage examination revealed that standard practices as laid down in SIDs or CPCP guidelines published by OEM were not meticulously followed at the time of inspection or maintenance activities, consequently resulting in poor condition of aircraft components like control cable and its pulleys. Further, after completion of maintenance or defect rectification, tasks were certified by the AME without ensuring the quality of actual work carried out on the aircraft.

As per TPM, the role & responsibilities of CAM employed with the organization is to ensure that the continuing airworthiness tasks are accomplished as per CAR M Sub Part C for the aircraft operated by the organization. Further, it is the responsibility of the CAM to ensure all maintenance is carried out on time as per program defined in their Engineering docs as per approved standards.

Aircraft condition at the time of accident indicates that neither the aircraft was maintained as per the approved program nor inspections standards were followed during those scheduled maintenance activities. Further, the maintenance program was not in conformity with the guidelines laid down by OEM as suggested for operational activities in coastal areas.

The aforementioned deficiencies establish that the company's post holders failed to comply with the regulations outlined in DGCA CAR Section 2. Furthermore, the aircraft was not maintained in accordance with the OEM's guidelines as outlined in the SID or CPCP program.

2.4.2 Non-adherence to AFM

Organisation was previously operating from its Nadirgul base which is located near Hyderabad but after the approval from DGCA, it has started regular operations from Nagarjunasagar since the year 2020 onwards. This operational base is in close vicinity to a large water body i.e. Nagarjunasagar Dam. Further, the sectors selected to impart cross country training flights are mainly towards coastal area as given in company documents, both TPM as well as FOB.

During the investigation, it is observed that M/s FAA is following the inspection frequency given for mild/moderate Corrosion environment. However, most of the cross country flying route being followed by M/s FAA lies almost in severe corrosion environment. Example of some cross country flying routes followed by M/s FAA are shown in the below Figure.

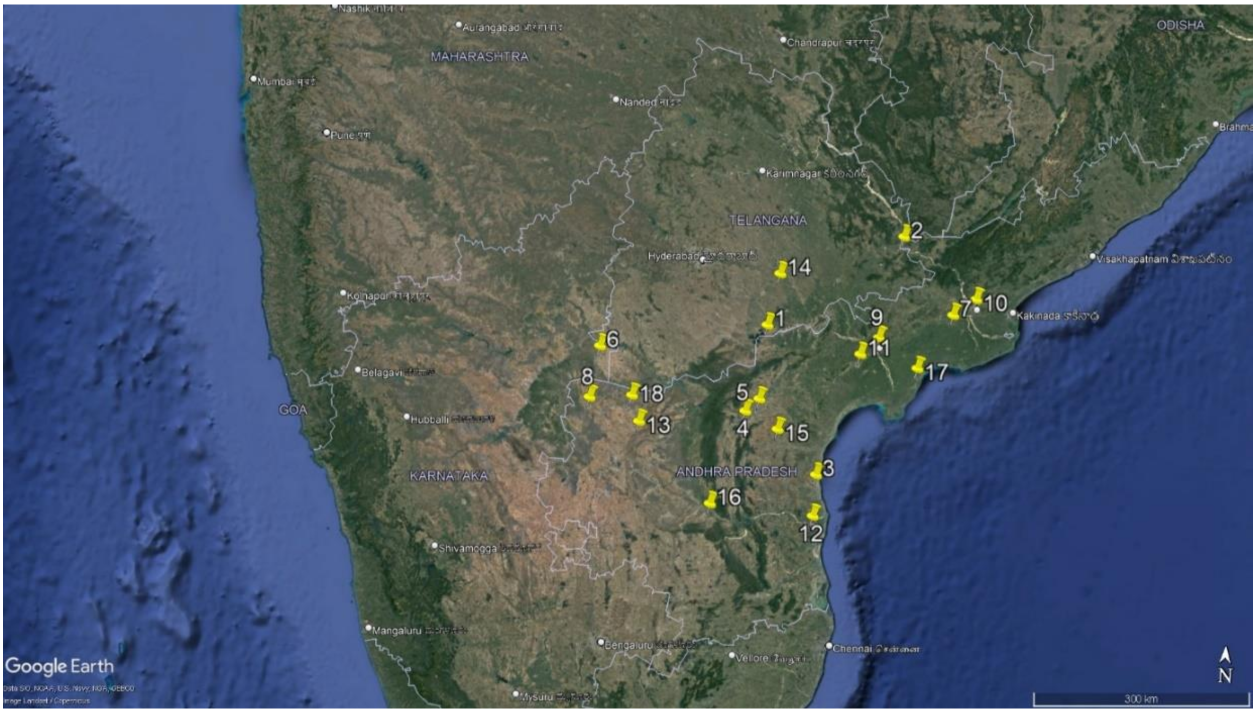


Figure 35: Cross country routes defined in FOB

As per OEM prescribed Corrosion Severity Guidelines, the AMP of the organization should cater for the enhanced inspections as per the CPCP for 'severe' areas. The same were however, found to be in compliance with the 'Moderate' areas only and the FTO did not revise the same after shifting their base for operations to Nagarjunsagar. Therefore, the level of maintenance inspections for corrosion was inadequate. This becomes all the more important in view of the fact that all the aircraft of the FTOs except one are more than 40 years old.

2.4.3 Lack of communication

In absence of any recording medium either in aircraft or local ATC, the recorded statements of ATC personnel, Flying Instructors and other trainee pilots were analyzed which showed ambiguity among their said statements.

During investigation person manning the Nagarjunasagar ATC was asked, if he tried to enquire as to why the aircraft was requesting to set course back. As per his statement, he had transmitted the message to know the intention of student pilot after clearance was given for 'setting course back'. However, no response was given by the student pilot.

The statements of other personnel (Student Pilot & Flying Instructors), however, differed and none of them reported to have heard any transmission enquiring reasons for turn back. The probability of transmission being missed by few is high, but it is unlikely that none of the aircraft in the vicinity did not heard the transmission.

Further, no repeated transmission by ATC personnel to know the intention for setting course back and waiting to get the response from student pilot itself shows lack of efforts on his part.

To mitigate these situations' philosophy of 'hearback' and 'readback' is already in place which clearly says that whenever an air traffic controller issues an instruction, pilots must acknowledge its reception and comply with it. Both persons involved must state their request/intentions, listen for feedback and acknowledge the other person's response. The listening portion of the cycle is just as important as the speaking portion.

It can be inferred from the above that personnel manning the ATC, though holding requisite qualifications, was lacking the basic knowledge to handle the ATC resulting into absence of communication between the aircraft and local ATC.

2.5 Implementation of Safety Recommendations

Provision to record and retrieve the VHF communication held between company aircraft and local ATC is presently nowhere mandated under DGCA regulations, therefore, operators do not have any setup for the same.

Though AAIB had recommended (as part of its report on accident to VT-CAF at Dhana on 3 Jan 2020 and accident to VT-RBE at Baramati on 20 Sep 2021) recording of communication between ATC and aircraft to DGCA, the recommendations are yet to be implemented.

In absence of VHF communication recordings, some of the crucial points pertaining to this investigation remain unanswered:

- Whether distress call was made or not during the entire flight?
- What was the exact cause for decision to discontinue the flight?
- If RT failed, why squawk facility was not utilized?

Early compliance of aforesaid recommendation will provide better monitoring and surveillance of training aircraft operating from uncontrolled airfields.

2.6 Circumstances leading to the Accident

The Flytech Aviation Academy shifted its base from Nadirgul to Nagarjunasagar in the year 2020. Due to change in the operational base, majority of flight routes on which the training flights were being carried out fell in the “Severe Corrosion Zone” as defined in the OEM’s AFM. The organization however, continued to follow the maintenance schedule that was approved by DGCA in accordance with requirements mandated for “Moderate Corrosion Zone”. Corrosion Control and Management Program, therefore was not being followed as required by the changed circumstances.

The organisation’s maintenance practices were poor and the inspections of the control cables indicated at lack of preventive maintenance on the aircraft. The photograph taken by the Student Pilot during the flight showed that aircraft’s suction gauge was showing nil reading though the aircraft was in power, indicating that it was faulty at the time of flight. Therefore, it is possible that the Attitude Indicator along with Directional Indicator might not have shown the correct readings.

On the day of accident, the aircraft took-off from Nagarjunasagar airfield in clear weather for a cross country flight overflying Raichur and to return to its base i.e. Nagarjunasagar. After completion of downwind, aircraft had joined the sector. While the aircraft was at around 10 nautical miles outbound, still flying over reservoir, Student pilot contacted local ATC and requested for setting course back. The reason for returning back was not communicated as per the FAA personnel manning the ATC. However, he did not ask for the same from the Student Pilot.

Analysis of Radar data revealed that after air turn back aircraft started flying towards north of Nagarjunasagar airfield instead of making direct approach for runway 09 over the water body.

The Student Pilot followed the TPM guidelines wherein emergency flights are restricted over reservoir area. Sector south which lacked enough forced landing fields due to hilly terrain was also avoided and aircraft followed the ground references leading towards Nagarjunasagar Dam. Aircraft's operated by training organization are further instructed to avoid an area of around 3 Nm north of airstrip while approaching for landing due to proximity of Nagarjunasagar Dam with the airfield. Accordingly, the student pilot continuously headed towards north and searched for suitable forced landing site. The aircraft was around 10 Nm north of Nagarjunasagar airstrip, when it disappeared from ATC Radar and the last height painted was FL34 at 0540 UTC.

The crash site shown in below fig is matching with the position of aircraft when it was last displayed on Radar screen.

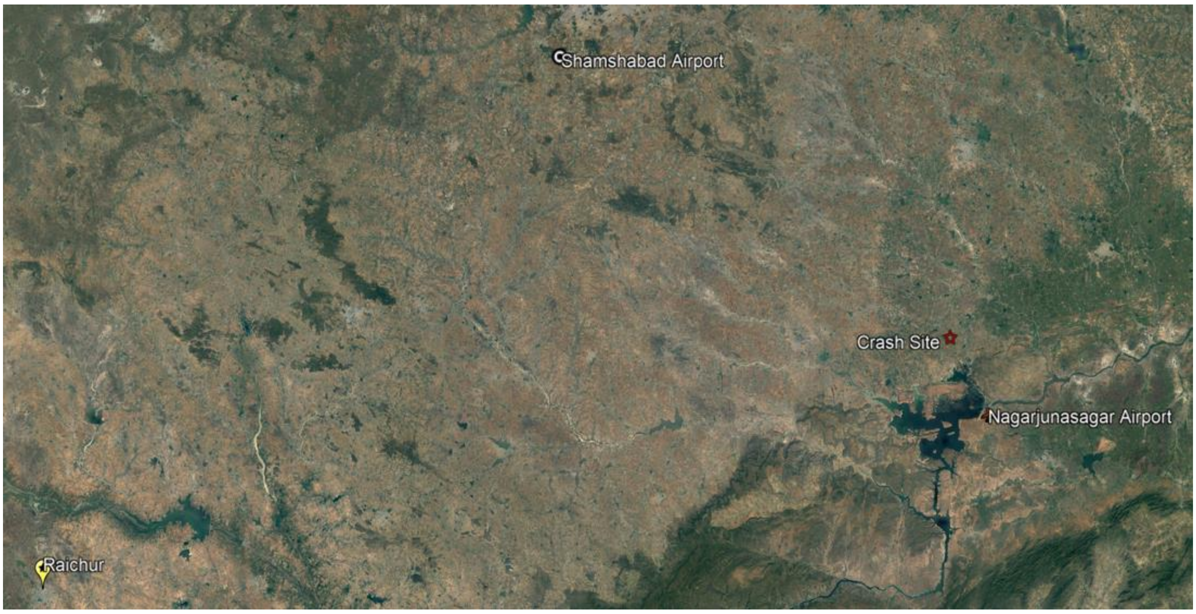


Figure 36: Crash Site

When the aircraft did not transmit any message for 10 minutes, ATC tried calling the aircraft but did not get any response. Other aircraft flying in the vicinity were asked to make contact with VT-FAO, however, there was no response.

The aircraft hit the ground in highly negative pitch attitude indicating that it was not in a landing configuration that is nose slightly up before touch down.

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 On 24 February 2022, maintenance activity was carried out on vacuum pump which is part of attitude indicator system. However, the attitude indicator was not serviceable during the accident flight.

3.1.4 On two consecutive days i.e. 24 and 25 Feb 2022, two maintenance inspections, Operation 22 and Operation 3, were carried out on the aircraft respectively.

3.1.5 While, no snag was documented pending on the aircraft prior to the accident flight, Investigation team found a number of deficiencies in maintenance.

3.1.6 As per the documents maintained by the operator, all Inspection Schedules (Operations) were complied on the aircraft. However, wreckage examination revealed that aircraft condition prior to the accident was not in line with work completed under those schedules.

3.1.7 Condition of few control cables and associated components were found beyond the limits. Lack of lubrication, corrosion and groove marks were noticed on few pulleys.

3.1.8 The main landing gear tyre without any tread mark (beyond tyre life) was found installed on the involved aircraft.

3.1.9 Few sections of the Tech log retrieved from the crash site were found blank and without acceptance column was filled aircraft was cleared for flying.

3.1.10 The Tech log of the aircraft contained ambiguous values for Oil consumption data.

3.1.11 Aircraft had sufficient fuel onboard to complete the cross-country flight before it took off from Nagarjunasagar. Ground marks as well as marks observed on propeller blades confirmed that aircraft engine was generating power when it hit the ground.

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

Weather

3.2.1 On the day of accident, weather around Nagarjunasagar and *enroute* was found conducive to carry out the cross-country training flight overhead Raichur.

3.2.2 At the time of accident, company aircraft's flying locally in other sectors did not observe any adverse weather in vicinity of Nagarjunasagar airfield.

Student Pilot

3.3.1 The Student Pilot was holding an SPL issued by the FTO and was meeting the necessary requirements to operate a cross country flight.

3.3.2 Student Pilot had successfully completed all exercises required to operate a solo cross country flight and was also familiar with the Raichur sector.

3.3.3 No distress or emergency call was given by the student pilot during the entire flight.

The student pilot had not undergone BA examination, but submitted the undertaking as per the provisions of DGCA CAR on consumption of alcohol or psychoactive substances.

Student Pilot adhered to the SOP defined in company documents and therefore avoided the direct approach for runway 09 and sector south while returning for Nagarjunasagar airfield.

Nagarjunasagar ATC

3.4.1 Although training sorties during day and night being scheduled at Nagarjunasagar airfield, only one company personnel was handling the ATC during those training flights.

3.4.2 ATC cleared the aircraft for setting course back. However, the intention for same was never enquired from the Student Pilot.

3.4.4 As per the ATC personnel statement, after setting course back, aircraft never reported about its position to ATC. ATC also did not monitor aircraft position once cleared to set course back.

3.4.5 After failing to establish contact with the aircraft ATC Hyderabad was contacted to provide the aircraft position.

Organisation

3.5.1 Although documents were produced to show that scheduled inspections were scrupulously followed, the Post holders failed to identify the latent hazards during those maintenance activities or inspections.

3.5.2 During maintenance, scheduled inspections or internal audits, organization failed to detect deteriorated conditions of control cables and other aircraft components/instruments.

3.5.3 The AMP and the maintenance were carried out as per "Moderate Corrosion Zone", however, the aircraft operated in "Severe Corrosion Zone".

3.2 Probable cause of the accident

The probable cause of the accident could not be established, but was likely to be technical issue affecting ability of aircraft to sustain flight. While the student pilot was flying low, searching for a suitable field to carry force landing, it is possible that student pilot might have made a sharp maneuver trying to avoid an obstacle or, control surfaces did not respond as per the control input; leading to loss of control.

The factors contributory to this accident are:

- Maintenance schedules not complying with OEM guidelines for flight operations in "Severe Corrosion Zone" leading to lack of adequate preventive maintenance on aircraft.
- Unserviceable cockpit instruments.
- Limited options for a quick turnback in case of emergency, owing to the geographical limitations.
- Lack of guidance available over VHF in case of emergency.

4. SAFETY RECOMMENDATIONS

It is recommended that

4.1 Recommendations of previous investigation reports on recording of RT transmission (VHF communication) between tower and aircraft operating under uncontrolled airfield should be implemented by DGCA on priority to enhance aircraft monitoring.

4.2 DGCA may carry out the audit of Nagarjunasagar airfield to access whether the airfield is suitable for flying training activities keeping in view the restricted areas and high-power transmission grid system in near vicinity.

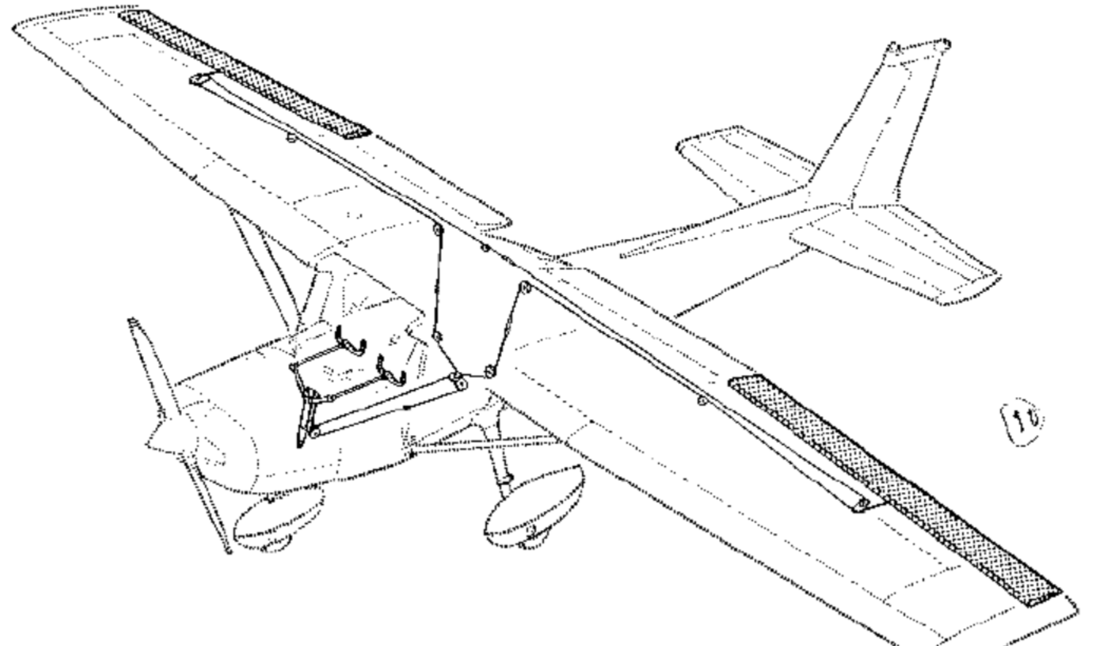
4.3 DGCA may issue instructions to M/s FAA to collect weather information for both base and *enroute* and to ensure that no flight is permitted if the data has not been recorded in MET register.

4.4 DGCA may advise all FTOs to issue instructions to flying trainees to communicate any anomaly observed during the flight to ATC in contact on priority without fail.

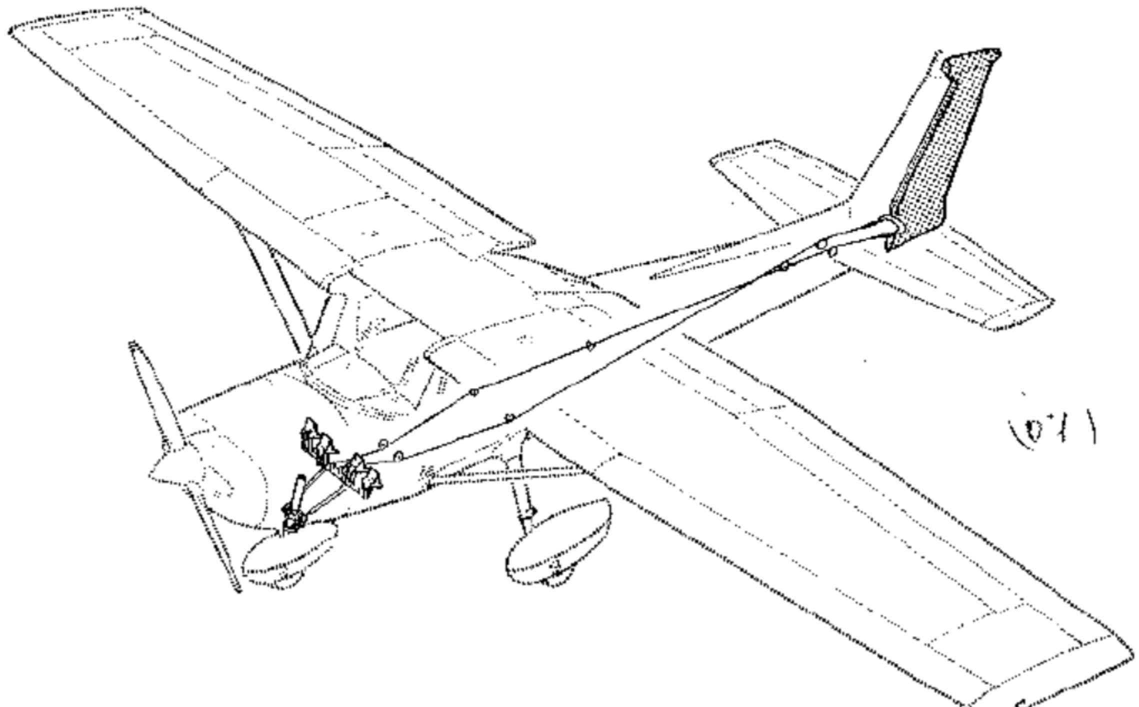
4.5 DGCA may issue instructions to FTOs to revise their existing maintenance program to incorporate the guidelines and procedures as laid down in AFM, in case its aircraft are being operated in severe corrosion zone as defined by OEM.

4.6 DGCA may carry out enhanced surveillance of all FTO’s where aircrafts older than 20 years are part of their fleet and are being utilized to impart training flights to assess their airworthy condition.

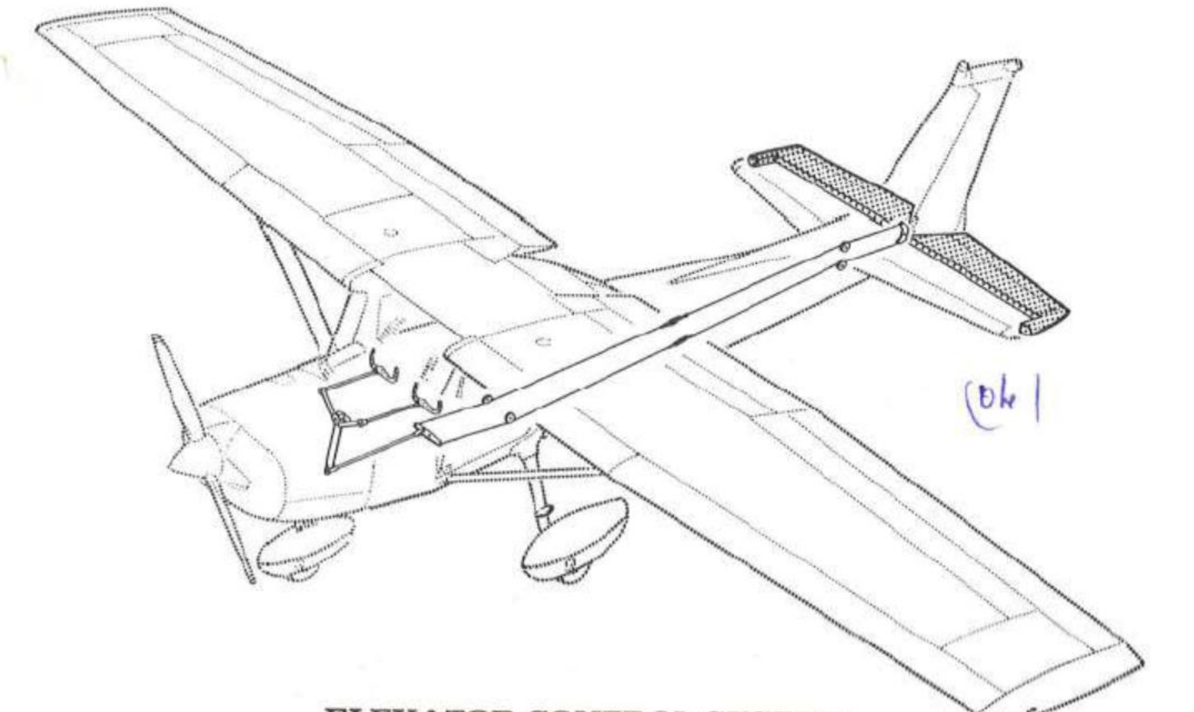
Flight Controls and Trim System



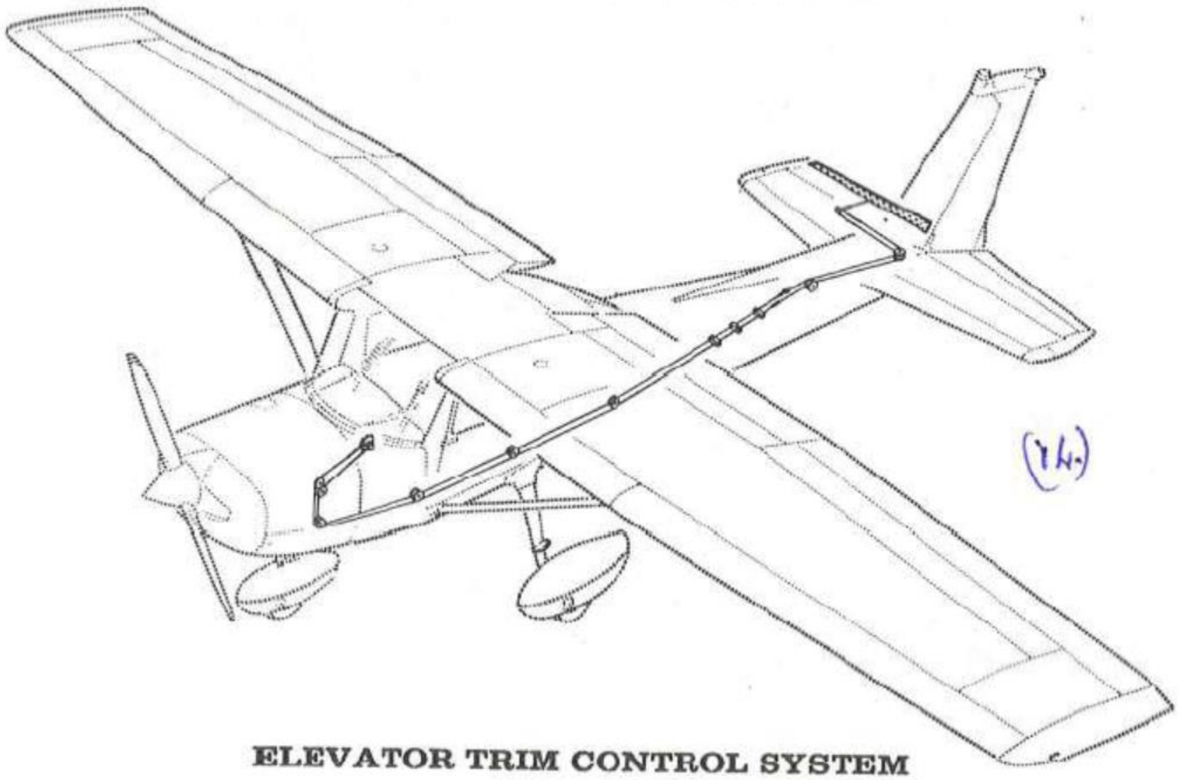
AILERON CONTROL SYSTEM



RUDDER CONTROL SYSTEM



ELEVATOR CONTROL SYSTEM

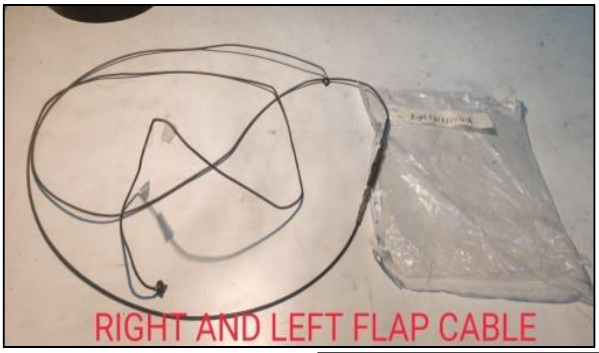


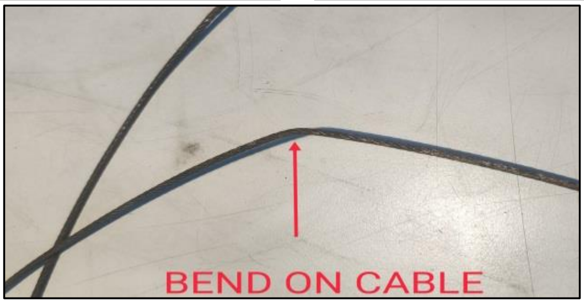
ELEVATOR TRIM CONTROL SYSTEM

Annexure B

Control Cable inspection carried out by DGCA approved Organisation

1. **Right and left flap cable**



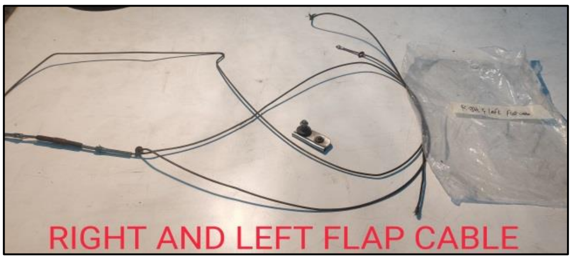


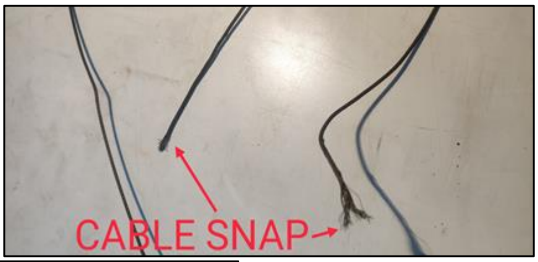
Obeservations

1. Condition of cable brownish mark on some areas.
2. At one location 3 strands broken.

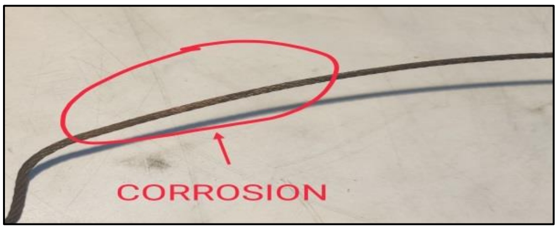
Remarks- Brownish marks and broken strand reflect poor maintenance practice.

2. **Right and left flap cable**





IMPORTANT EVIDENCE

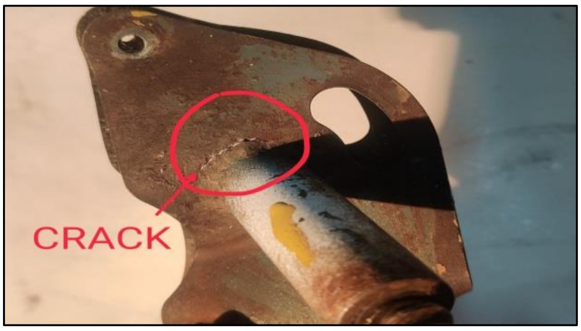


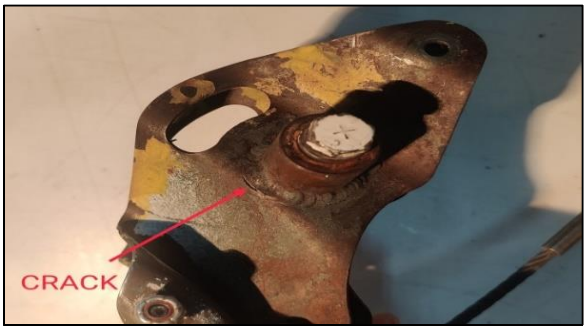
Observations

1. Cable found broken
2. Engineer opinion- Cable snap during crash. At the location of snap there is no substantial brown marking. Reason of cable snaping is accident.
3. Multiple corrosion observed on cable.
4. Cable broken at one point.
5. At on location there is kink in the cable.

Remarks- Brownish marks and corrsion show poor maintenance practices . However cable at cable snappining there are no brown marks.

3. Right aileron

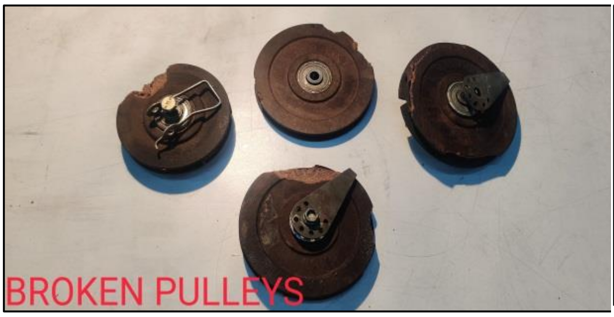


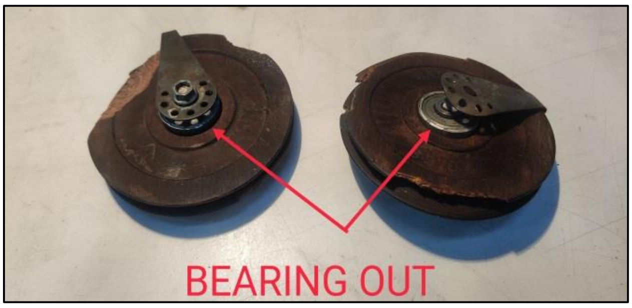


Observations-

1. Cable locking not present, may be removed by engineer after crash.
2. Quadrant- welding crack found may be due to crash.

4. Elevator

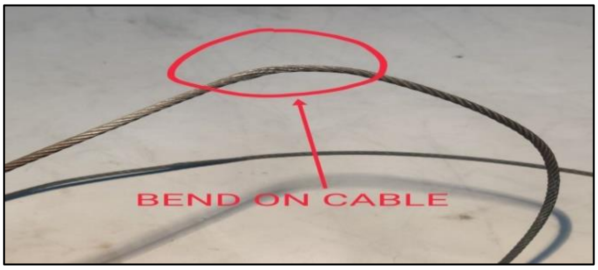




Observations-

1. On 2 pulleys (size- 3.5'' dia)- bearing comes out from pulley bearing checked for free rotation found ok.
2. Many pulley broken may be at the time of accident.
3. On one pulley (size- 3.5'' dia) cable guide found bend.

5. Left aileron

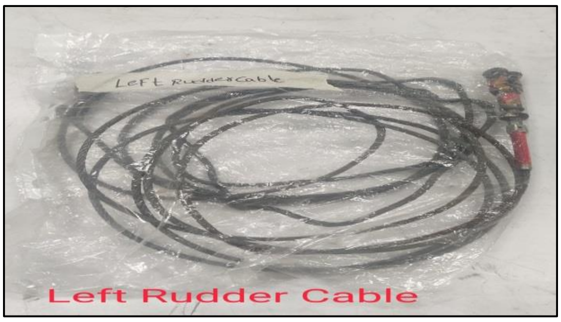


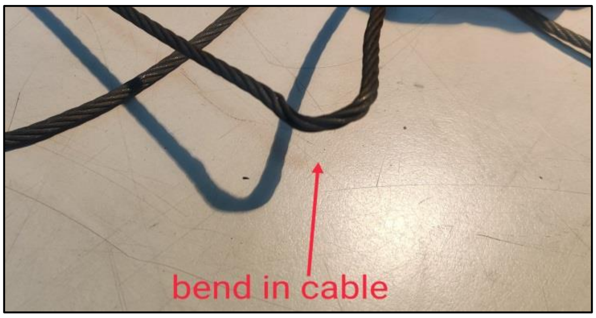
Observations-

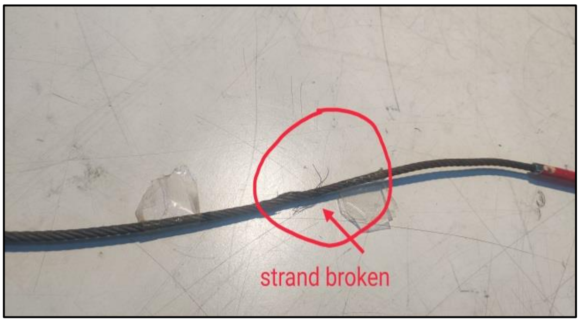
1. Turnbuckle locking not present (may be removed by engineer)
2. Rubbing marks observed on some part of cable. May be due to slip of the cable over pulley.
3. Bend found on the cable may be at the time of accident.

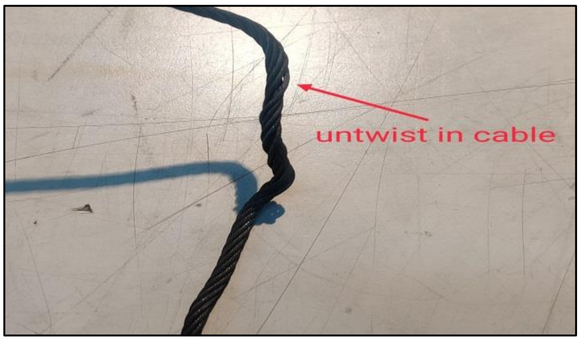
Remarks-Rubbing marks on cable may be due to cable slipping on pulley
Recommendations- Check condition of pulley rotation and cable tension on regular interval

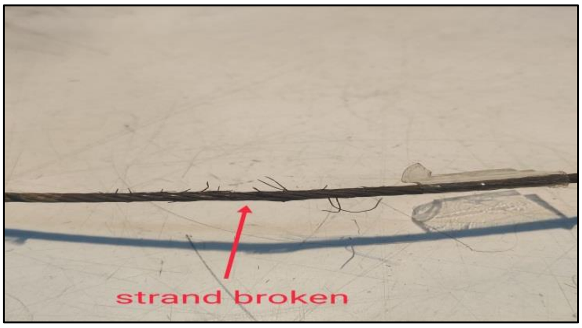
6. Left rudder cable

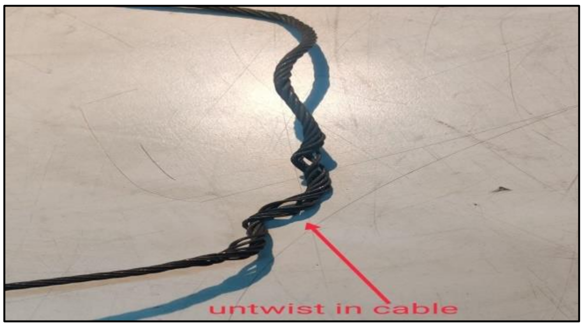










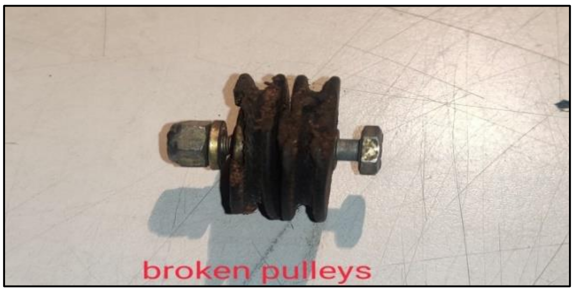


Observation-

1. Cable found corroded at many places and many strands found broken 26 cm away from adjustable fork end.
2. No locking found on adjustable fork end.
3. Cable found bend at 38 cm from fixed fork end.
4. At one location , cable found untwisted (8 cm long) at 75 cm from fixed fork end and at 100 cm from the fixed fork end (unwisted length 3 cm).
5. corrosion observed on many places.

Remarks-Strand broken reflective of poor maintenance practices. Unwind in cable does not unless cable is mishandled.

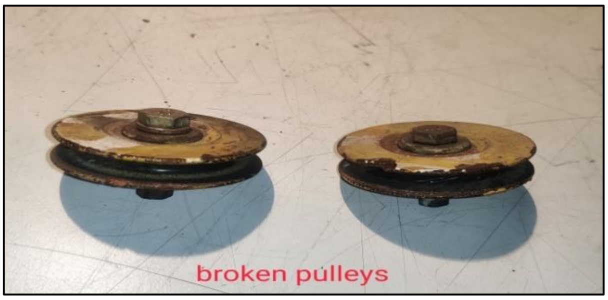
7. Elevator trim tab



Observations- dia – 30mm

1. One pulley found half broken. Bearing found free of rotation.
2. Two pulleys have binding.
3. Two pulleys have got side play in bearing (bearing worn out).
4. One pulley broken and binding observed. Another pulley broken and free of rotation.

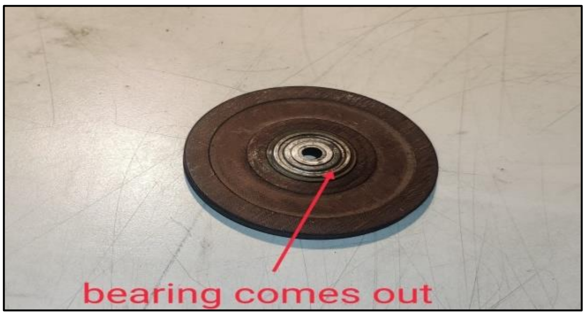
8. Rudder pulleys

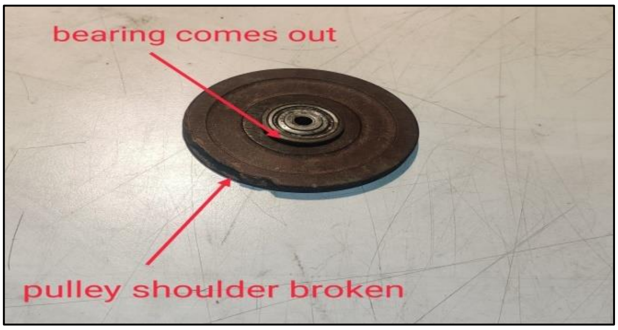


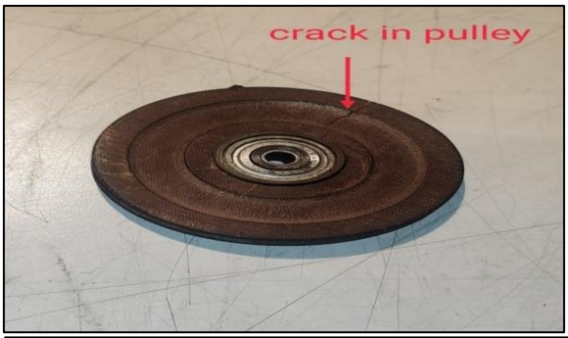
Observations- dia- 50 mm

1. In two pulleys, inner race of the bearing found loose and have play (bearing worn out).
2. Two pulleys broken but bearing free to rotate.
3. One pulley with mounting, cable guide and bracket found broken. Bearing rotation found satisfactory.

9. Flap and ailerons pulleys







Observations- dia- 60 mm

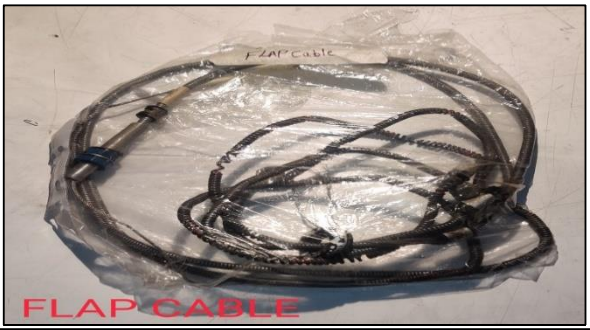
1. One pulley bearing comes out of the pulley.
2. On one pulley, bearing comes out of the pulley and pulley shoulder also found broken.
3. Crack found on pulleys on one of the pulley and bearing found jammed.
4. Another bearing found broken and binding observeed in bearing.
5. On one pulley minor damage observed. However, bearing is free to rotate.
6. On two pulley (**dia- 750 mm)** pulley shoulder broken . Bearing is free to rotate.

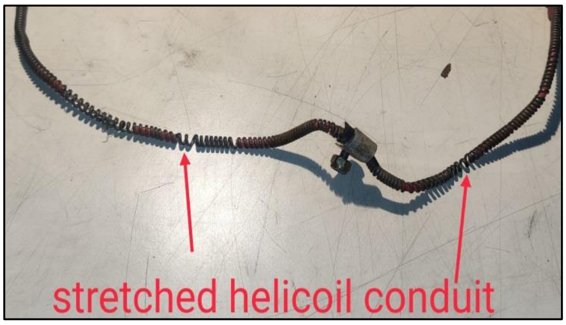
10. Rudder horn

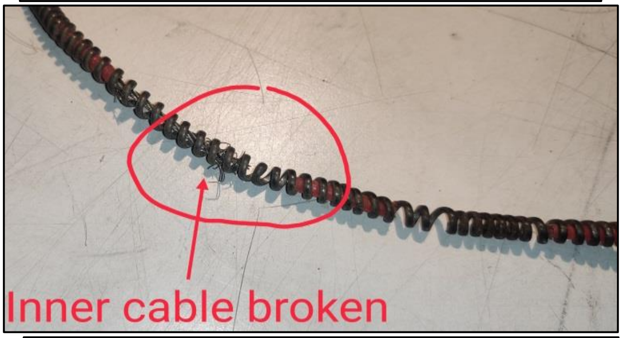
Observations-

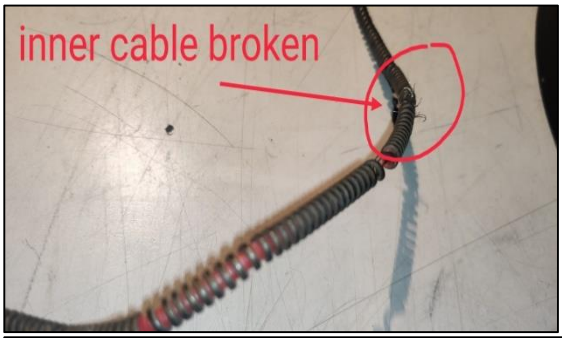
1. Rudder horn found distorted and slight damage marks observed, may be due to accident.

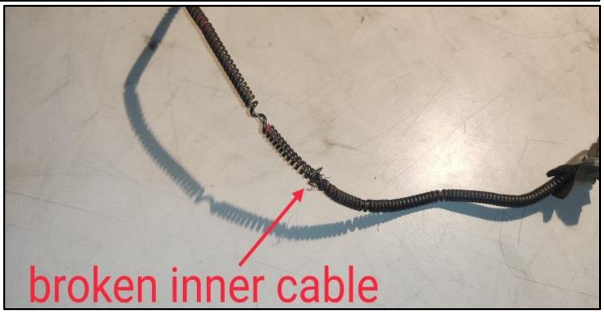
11. Flap cable

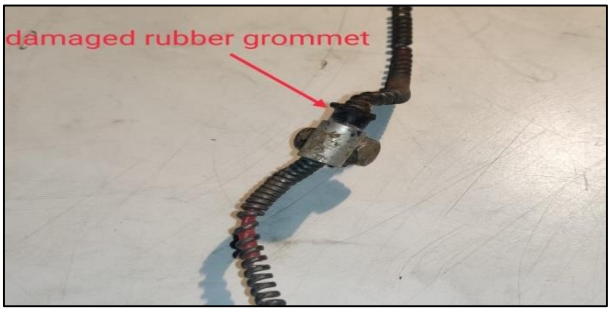








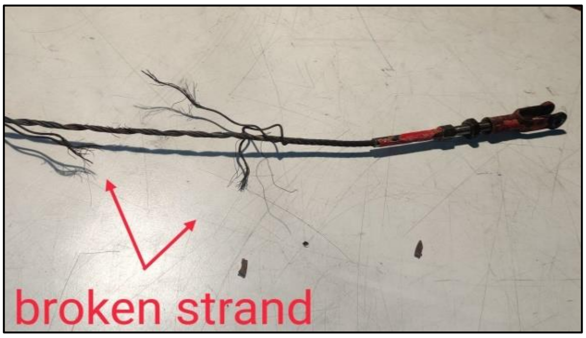


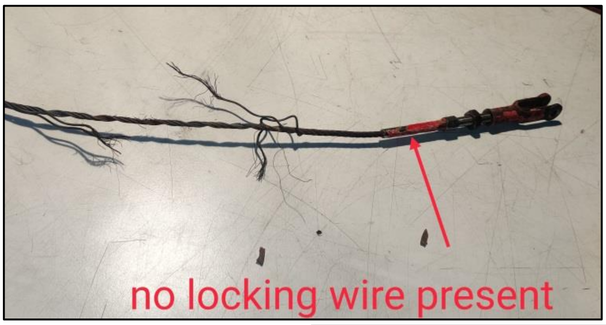


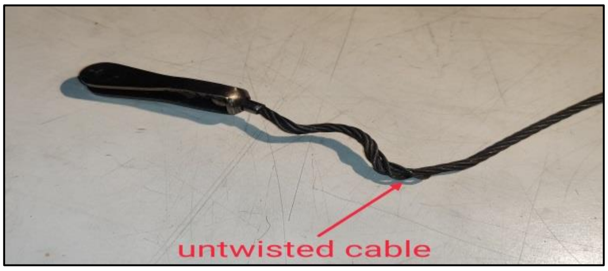
Observations- conduit dia- ¼'' and cable dia 1/16''

1. Outer flexible helicoil conduit found strached at many location.
2. Inner cable found broken at many places.
3. Clamp and rubber grommet found damaged.

12. Right rudder cable





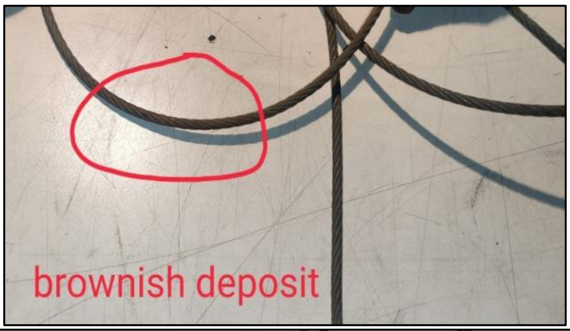


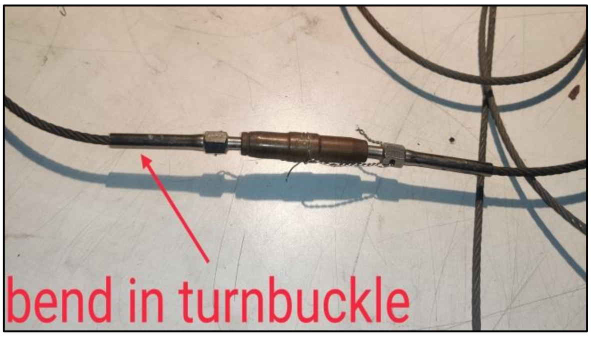
Observations-

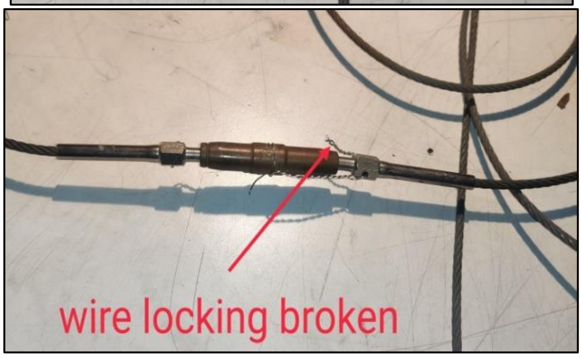
1. At 25 cm from the adjustable fork end, cable found corroded and 50 % of the strand found broken.
2. No locking wire found on the adjustable fork end.
3. Cable found untwisted (approx 10 cm) from the fixed fork end.
4. At approx (1 m) from the fixed fork end, cable found bend and some of the strands found broken.

Findings-Broken strands - unacceptable maintenance practices

13. Right through left aileron



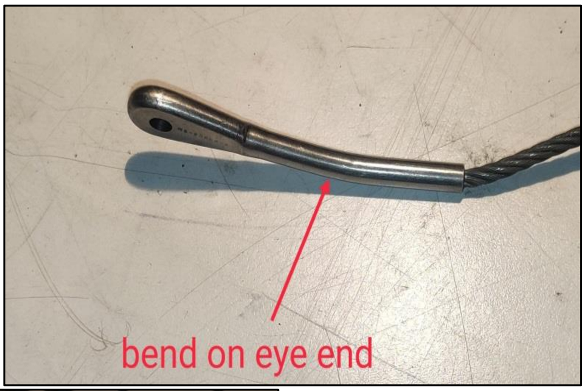




Observation-

1. At some places, brownish deposit found.
2. Trunbuckle found bend, locking wire found broken

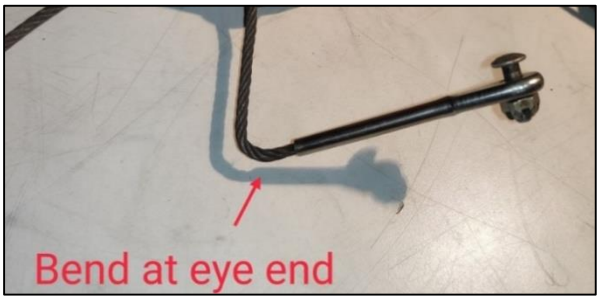
14. Left elevator cable



Observation- (dia- 1/8'')

1. Bend on eye end.
2. Turnbuckle found bend and wire locked.
3. Cable condition satisfactory.

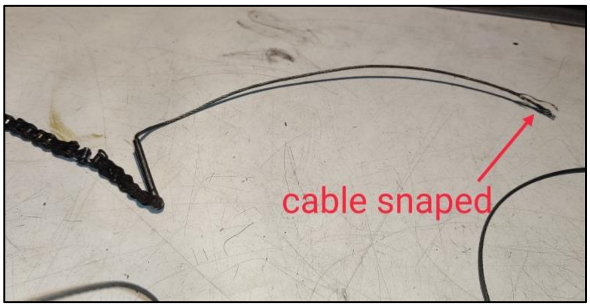
15. Right elevator cable

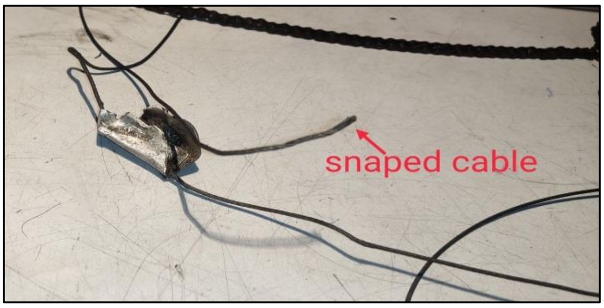


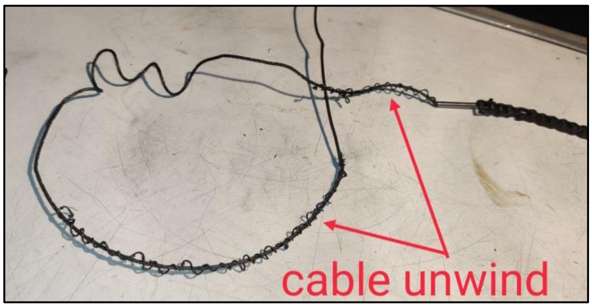
Observation-dia- 1/8''

1. Bend found on cable, 8 cm from eye end .
2. Bend found on trunbuckle.
3. Brown deposite found on cable (66 cm from fixed fork end).
4. At 66 cm from fixed fork end, strand found broken and wear marks (8 cm long) found on the cable.
5. 26 cm from the eye end , slight damage found on the cable.

16. Trim tab cable



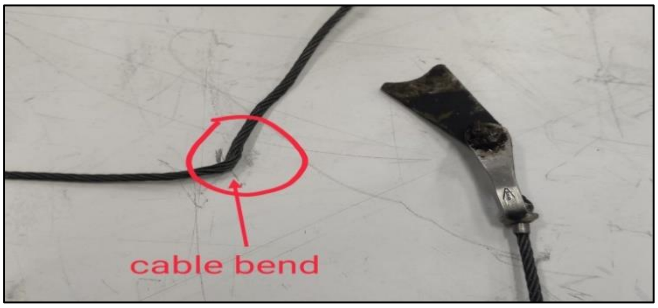




Observations- dia 1/16''

1. Chain found broken.
2. One eye end from chain found detached.
3. Another end (30 cm from eye end) found snapped.
4. From detached end, cable found unwinded and broken. At 60 cm from detached eye end, strand found broken.
5. At 30 cm from detached end cable found snapped.
6. Turnbuckle found bend and wire locked.
7. At many places wire is untwisted.

17. Right aileron



Observations-

1. At one meter from fork end cable found bend.
2. Slight untwisted cable observed at many places.
3. 11 cm from the turnbuckle end, cable found partially snapped.

Summary

1. At many places corrosion observed on cables suggestive of improper maintenance practices being followed during the scheduled inspections
2. At some places broken cable strands were found which is a unacceptable maintenance practice
3. One cable was found snapped - may be due to crash
4. Cable unwinding was observed- normally happens if mishandled. Most probably it happened during removal of cables after crash
5. On some pulleys slip signs were observed indicating improper maintenance practices being followed
6. Turnbuckle was found bent and one welding crack was observed etc- probably caused by accident
7. Cables were found bent at few places- probably caused by accident

Annexure C

OEM Guidelines on Control Cables

EXPANDED MAINTENANCE

1. Control Cables

A. The chromium nickel steel wire is helically twisted into strands and the strands laid about other strands forming the flexible steel cable. The diameter of the cable is determined by the number of wires and the number of strands in the cable.

(1) Construction of Cables

(a) Cable diameter, 1/32 inch, 3 by 7 construction - Cable of this construction shall consist of three strands of seven wires each. There shall be no core in this construction. The cable shall have a length of lay of not more than eight times nor less than five times the nominal cable diameter.

(b) Cable diameter, 1/16 inch and 3/32 inch, 7 by 7 construction - Cable of this construction shall consist of six strands of seven wires each, laid around a core strand of seven wires. The cable shall have a length of lay of not more than eight times nor less than six times the nominal cable diameter.

(c) Cable diameter, 1/8 inch through 3/8 inch, 7 by 19 construction - Cable of this construction shall consist of six strands laid around a core strand. The wire composing the seven individual strands shall be laid around a central wire in two layers. The single core strand shall consist of a layer of 6 wires laid around the central wire in a right direction and a layer of 12 wires laid around the 7 wire strand in a right direction. The 6 outer strands of the cable shall consist of a layer of 6 wires laid around the central wire in a left direction and a layer of 12 wires laid around the 7 wire strand in a left direction.

(d) Lubrication - A pressure type friction preventative compound, having noncorrosive properties, is applied during construction as follows:

• Friction preventative compound is continuously applied to each wire as it is formed into a strand so that each wire is completely coated.

• Friction preventative compound is continuously applied to each strand as it is formed into a cable so that each strand is completely coated.

(e) Definitions - The following definitions pertain to flexible steel cable:

- Wire - Each individual cylindrical steel rod or thread shall be designated as a wire.
- Strand - Each group of wires helically twisted or laid together shall be designated as a strand.
- Cable - A group of strands helically twisted or laid about a central core shall be designated as a cable. The strands and the core shall act as a unit.
- Diameter - The diameter of cable is the diameter of the circumscribing circle.
- Wire Center - The center of all strands shall be an individual wire and shall be designated as a wire center.

- Strand Core - A strand core shall consist of a single straight strand made of preformed wires, similar to the other strands comprising the cable in arrangement and number of wires.
- Preformed Type - Cable consisting of wires and strands shaped, prior to fabrication of the cable, to conform to the form or curvature which they take in the finished cable, shall be designated as preformed types.
- Lay or Twist - The helical form taken by the wires in the strand and by the strands in the cable is characterized as the lay or twist of the strand or cable respectively. In a right lay, the wires or strands are in the same direction as the thread on a right screw and for a left lay, they are in the opposite direction.
- Pitch (or length of lay) - The distances, parallel to the axis of the strand or cable, in which a wire or strand makes one complete turn about the axis, is designated as the pitch (or length of lay) of the strand or cable respectively.

CORROSION PREVENTION AND CONTROL PROGRAM (CPCP)

1. Introduction

A. As the airplane ages, corrosion occurs more often, while, at the same time, other types of damage such as fatigue cracks occur. Corrosion can cause damage to the airplane's structural integrity and if it is not controlled, the airframe will carry less load than what is necessary for continued airworthiness.

(1) To help prevent this, we started a Corrosion Prevention and Control Program (CPCP). A CPCP is a system to control the corrosion in the airplane's primary structure. It is not the function of the CPCP to stop all of the corrosion conditions, but to control the corrosion to a level that the airplane's continued airworthiness is not put in risk.

B. Complete the initial CPCP inspection in conjunction with the first SID inspection.

2. Corrosion Prevention and Control Program Objective

A. The objective of the CPCP is to help to prevent or control the corrosion so that it does not cause a risk to the continued airworthiness of the airplane.

3. Corrosion Prevention and Control Program Function

A. The function of this document is to give the minimum procedures necessary to control the corrosion so that the continued airworthiness is not put in risk. The CPCP consists of a Corrosion Program Inspection number, the area where the inspection will be done, specified corrosion levels and the compliance time. The CPCP also includes procedures to let Cessna Aircraft Company and the regulatory authorities know of the findings and the data associated with Level 2 and Level 3 corrosion. This includes the actions that were done to decrease possible corrosion in the future to Level 1.

B. Maintenance or inspection programs need to include a good quality CPCP. The level of corrosion identified on the Principal Structural Elements (PSEs) and other structure listed in the Baseline Program will help make sure the CPCP provides good corrosion protection.

NOTE: A good quality program is one that will control all structural corrosion at Level 1 or better.

C. Corrosion Program Levels.

NOTE: In this manual the corrosion inspection tasks are referred to as the corrosion program inspection.

(1) Level 1 Corrosion.

(a) Corrosion damage occurring between successive inspection tasks, that is local and can be reworked or blended out with the allowable limit.

(b) Local corrosion damage that exceeds the allowable limit but can be attributed to an event not typical of the operator's usage or other airplanes in the same fleet (e.g., mercury spill).

(c) Operator experience has demonstrated only light corrosion between each successive corrosion task inspection; the latest corrosion inspection task results in rework or blend out that exceeds the allowable limit.

(2) Level 2 Corrosion.

(a) Level 2 corrosion occurs between two successive corrosion inspection tasks that requires a single rework or blend-out that exceeds the allowable limit. A finding of Level 2 corrosion requires repair, reinforcement or complete or partial replacement of the applicable structure.

(3) Level 3 Corrosion.

(a) Level 3 corrosion occurs during the first or subsequent accomplishments of a corrosion inspection task that the operator determines to be an urgent airworthiness concern.

4. References

A. This is a list of references for the Corrosion Prevention and Control Program.

(1) FAA Advisory Circular AC120-CPCP, Development and Implementation of Corrosion Prevention and Control Program

(2) FAA Advisory Circular AC43-4A, Corrosion Control for Aircraft

(3) Cessna Illustrated Parts Catalog - part numbers P692-12.

(4) Cessna Service Manual - part number D2064-1-13.

5. Control Prevention and Control Program Application

A. The Corrosion Prevention and Control Program gives the information required for each corrosion inspection. Maintenance personnel must fully know about corrosion control. The regulatory agency will give approval and monitor the CPCP for each airplane.

(1) The CPCP procedures apply to all airplanes that have exceeded the inspection interval for each

location on the airplane. Refer to the Glossary and the Baseline Program.

(a) Cessna Aircraft Company recommends that the CPCP be done first on older airplanes and areas that need greater changes to the maintenance procedures to meet the necessary corrosion prevention and control requirements.

(2) Maintenance programs must include corrosion prevention and control procedures that limit corrosion to Level 1 or better on all Principal Structural Elements (PSEs) and other structure

specified in the Baseline Program. If the current maintenance program includes corrosion control procedures in an inspection area and there is a report to show that corrosion is always controlled to Level 1 or better, the current inspection program can be used.

(a) The Baseline Program is not always sufficient if the airplane is operated in high humidity (severe) environments, has a corrosive cargo leakage or has had an unsatisfactory maintenance or repair. When this occurs, make adjustments to the Baseline Program until the corrosion is controlled to Level 1 or better. Refer to Section 2A-30-01, Corrosion Severity Maps, to determine the severity of potential corrosion.

(3) The CPCP consists of the corrosion inspection applied at a specified interval and, at times, a corrosion inspection interval can be listed in a Service Bulletin. For the CPCP to be applied, remove all systems, equipment and interior furnishings that prevent sufficient inspection of the structure. A non-destructive test (NDI) or a visual inspection can be necessary after some items are removed if there is an indication of hidden corrosion such as skin deformation, corrosion under splices or corrosion under fittings. Refer to the Baseline Program.

(4) The corrosion rate can change between different airplanes. This can be a result of different environments the airplane operates in, flight missions, payloads, maintenance practices (for example more than one owner), variation in rate of protective finish or coating wear.

(a) Some airplanes that operate under equivalent environments and maintenance practices can be able to extend the inspection intervals if a sufficient number of inspections do not show indications of corrosion in that area. Refer to the Glossary.

(5) Later design and/or production changes done as a result of corrosion conditions can delay the start of corrosion. Operators that have done corrosion-related Service Bulletins or the improved procedures listed in the Corrosion Program Inspection can use that specified inspection interval. Unless the instructions tell you differently, the requirements given in this document apply to all airplanes.

(6) Another system has been added to report all Level 2 and Level 3 corrosion conditions identified during the second and each subsequent CPCP inspection. This information will be reviewed by Cessna Aircraft Company to make sure the Baseline Program is sufficient and to change it as necessary.

6. Baseline Program

A. The Baseline Program is part of the Corrosion Prevention and Control Program (CPCP). It is divided into Basic Task and Inspection Interval. In this manual the Basic Tasks are referred to as the Corrosion Program Inspection. This program is to be used on all airplanes without an approved CPCP. Those who currently have a CPCP that does not control corrosion to Level 1 or better must make adjustments to the areas given in the Baseline Program.

B. Typical Airplane Zone Corrosion Program Inspection Procedures.

(1) Remove all the equipment and airplane interior (for example the insulation, covers and, upholstery) as necessary to do the corrosion inspection.

(2) Clean the areas given in the corrosion inspection before you inspect them.

(3) Do a visual inspection of all of the Principal Structural Elements (PSEs) and other structure given in the corrosion inspection for corrosion, cracking and deformation.

(a) Carefully examine the areas that show that corrosion has occurred before.

NOTE: Areas that need a careful inspection are given in the corrosion inspection.

(b) Nondestructive testing inspections or visual inspections can be needed after some disassembly if the inspection shows a bulge in the skin, corrosion under the splices or corrosion under fittings. Hidden corrosion will almost always be worse when fully exposed.

(4) Remove all of the corrosion, examine the damage and repair or replace the damaged structure.

(a) Apply a protective finish where it is required.

(b) Clean or replace the ferrous metal fasteners with oxidation.

(5) Remove blockages of foreign object debris so that the holes and clearances between parts can drain.

(6) For bare metal on any surface of the airplane, apply corrosion prevention primer, refer to the Application of Corrosion Preventative Compounds.

(a) Apply a polyurethane topcoat paint to the exterior painted surface. Refer to the manufacturer's procedures.

(7) Install the dry insulation blankets.

(8) Install the equipment and airplane interior that was removed to do the corrosion inspection.

7. Baseline Program Implementation

A. The Baseline Program is divided into specific inspection areas and zone locations. The inspection areas and zone locations apply to all airplanes. Refer to Figure 1, Airplane Zones.

8. Reporting System

A. Corrosion Prevention and Control Program Reporting System (Refer to Figure 2).

(1) The Corrosion Prevention and Control Program (CPCP) includes a system to report to Cessna Aircraft Company data that will show that the Baseline Program is sufficient and, if necessary, make changes.

(2) At the start of the second Corrosion Program Inspection of each area, report all Level 2 and Level 3 Corrosion results that are listed in the Baseline Program to Cessna Aircraft Company.

Send the Control Prevention and Control Program Damage Reporting Form to: Cessna Aircraft

Company, Customer Service, P.O. Box 7706, Wichita, KS, 67277 USA Phone: (316) 517-5800,

FAX: (316) 517-7271.

9. Periodic Review A. Use the Service Difficulty Reporting System to report all Level 2 and Level 3 Corrosion results to the FAA and to Cessna Aircraft Company. All corrosion reports received by Cessna Aircraft Company will be reviewed to determine if the Baseline Program is adequate.

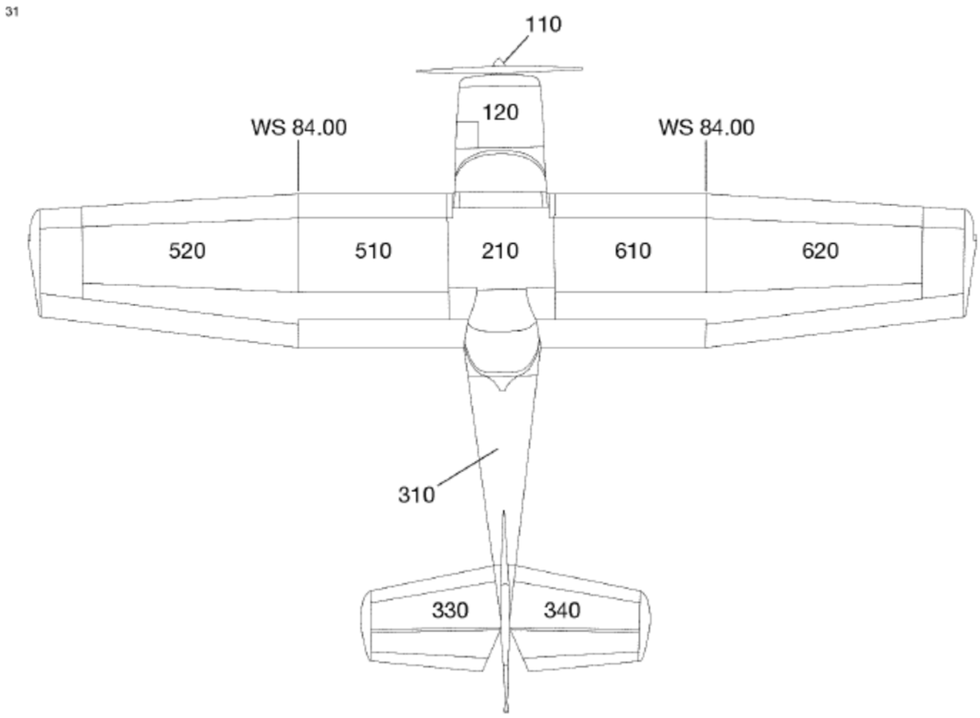


Fig: Airplane Zones

10. Corrosion Related Airworthiness Directives

A. Safety-related corrosion conditions transmitted by a Service Bulletin can be mandated by an Airworthiness Directive (AD). Airworthiness Directives can be found on the FAA website: www.faa.gov.

11. Appendix A - Development Of The Baseline Program

A. The Corrosion Prevention and Control Program Baseline Program

(1) The function of the Corrosion Prevention and Control Program (CPCP) is to give the minimum procedures necessary to prevent and control corrosion so that continued airworthiness is not at risk. The Principal Structural Elements (PSE's) are areas where the CPCP applies.

(2) The CPCP Baseline Program consists of a Corrosion Program Inspection (CPI) and an inspection time. Each inspection is to be done in an airplane zone.

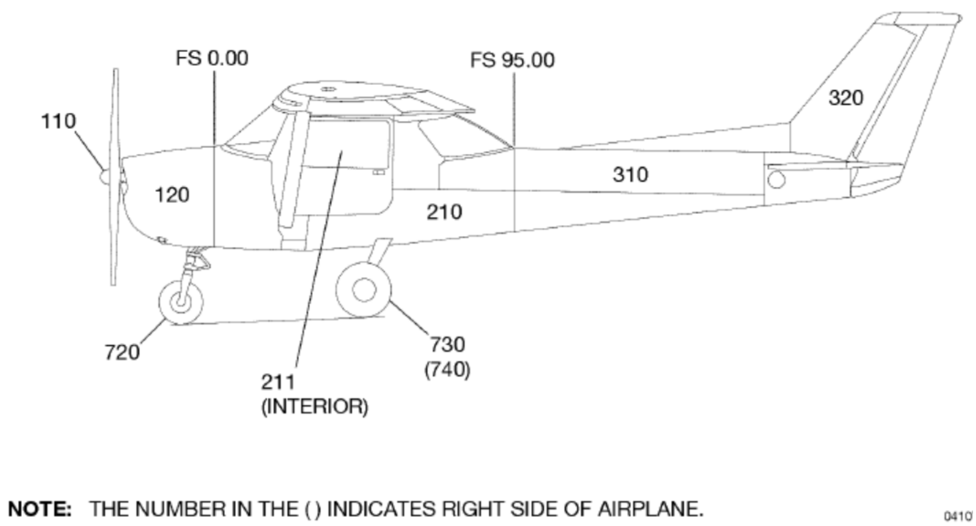


Fig: Airplane Zones

(3) The corrosion reports that are sent to Cessna Aircraft Company and data from the FAA Service Difficulty Records were used to identify the inspection areas of the Baseline Program. When more than one incident of corrosion was identified at a specified location, an inspection was included for that location in the Baseline Program.

(4) When corrosion was found once, the data was examined to find if the corrosion was caused by one specified occurrence or if other airplanes could have corrosion in the same location. If the corrosion is not linked to one specific occurrence, the inspection should be added to the Baseline Program.

(5) The inspection interval was specified by the duration and corrosion severity.

12. Appendix B - Procedures for Recording Inspection Results

A. Record the Inspection Results.

(1) It is not an FAA mandatory procedure to record the CPCP results, but Cessna Aircraft Company recommends that records be kept to assist in program adjustments when necessary. The inspection of records will make sure the identification, repeat inspections and level of corrosion are monitored. The data can identify whether there is more or less corrosion at repeat intervals. The data can also be used to approve increased or decreased inspection intervals.

16. Corrosion Inspections and Detection Methods

A. Typical Inspection Methods.

(1) Remove all equipment or components that can interfere with your ability to clearly view the inspection area.

NOTE: In some areas it may be necessary to use equipment such as a borescope to see the inspection area.

(2) Fully clean the inspection area before starting the inspection.

(3) Carefully examine the inspection area for any indication of corrosion. Refer to Section 2A-30-01- Corrosion, for additional information on the common indications that corrosion has occurred.

(a) Special attention should be given to inspection areas that have had corrosion repairs in the past.

(b) Nondestructive testing can be necessary after some disassembly if the inspection shows a bulge in the skin or corrosion below structural splices or fittings.

6. General

A. This section contains maps which define the severity of potential corrosion on airplane structure.

B. Corrosion severity zones are affected by atmospheric and other climatic factors. The maps provided in this section are for guidance when determining types and frequency of required inspections and other maintenance.