

SYNOPSIS:-

Cessna-FA152 aircraft VT-EMU operated by M/s. M.P. Flying Club was engaged in a dual flying for touch and go exercise at Devi Ahilyabai Holkar Airport, Indore on 12/06/2013. At around 1251UTC, during second sortie while climbing on the crosswind leg at approx. 2200ft, abnormal noise was heard by the crew from the engine, followed by vibrations and complete power loss. The instructor took over the controls of the aircraft and turned the aircraft towards the runway. Meantime he tried to recycle the throttle in order to regain power, but there was no response. The instructor selected an open field and carried out forced landing on cultivatable land just outside the airport. When the aircraft was about to stop, the nose wheel mired in soft soil and the aircraft toppled.

The occurrence was informed to DGCA, India and the investigation was carried out by an inquiry officer appointed by DGCA, India vide order No. AV 15019/50/2013-AS dated 10/07/2013 under rule 13(1) of the aircraft (Investigation of accidents and incidents) rule 2012.

The most probable cause for the incident to happen was due to total oil replenishment was not carried out as per the 50Hrs. approved scheduled and only topping up of engine oil was carried out which has lead the engine oil properties to change significantly and in turn for heavy carbon deposit on the spark plugs that has resulted insufficient burning of charges inside the cylinder and lack of lubrication lead to seizure of no. 3 piston in the cylinder routed for loss of power on the engine.

1. FACTUAL INFORMATION

1.1 History of the flight.

Cessna-FA 152 aircraft VT-EMU belonging to M/s Aero club of India, New Delhi and operated by M/s. M.P Flying Club was released for training flight by an Aircraft Maintenance Engineer after carrying out daily inspection on 12/06/13 at Indore at 0700 hrs (IST) with 100 Ltrs. of fuel and 6ltrs. of engine oil onboard. The planned exercises were circuit and landings.

As per Met report issued at 1230UTC and at 1300UTC, the weather conditions were ideal to carry out VFR flight. As per Assistant Pilot Instructor (API), before taxing out they did all the run up checks including mag drop & static RPM checks which were satisfactory & within limits. After the permission from the ATC, Indore at around 1230UTC, the trainee pilot carried out pre-start up and start up checks under supervision of API. Fuel on board was approx. 45 ltrs. in each wing tank. Before taxi, they did the run up checks including mag drop check and static rpm check and were found within normal limit. They taxied the aircraft to runway 25 and after lined up, carried out pre take off checks. The aircraft got airborne from Indore Airport at 1244 UTC for the first local circuit and landing sortie and landed successfully. While the aircraft was on final on Rwy25, the aircraft requested for

short circuit and accordingly permission was granted by Indore ATC. At around 1251 UTC, the student pilot carried out second circuit (Left circuit pattern).

When aircraft was in climb phase on the crosswind leg at approx. 2200ft, crew heard abnormal noise from the engine followed by vibrations and complete power loss. At this point, the instructor took over the controls of the aircraft and turned the aircraft towards the runway. He tried to recycle the throttle in order to regain power, but there was no response. The instructor selected an open field for emergency forced landing. During emergency forced landing, when the aircraft was about to stop, the nose wheel mired in soft soil and the aircraft toppled.

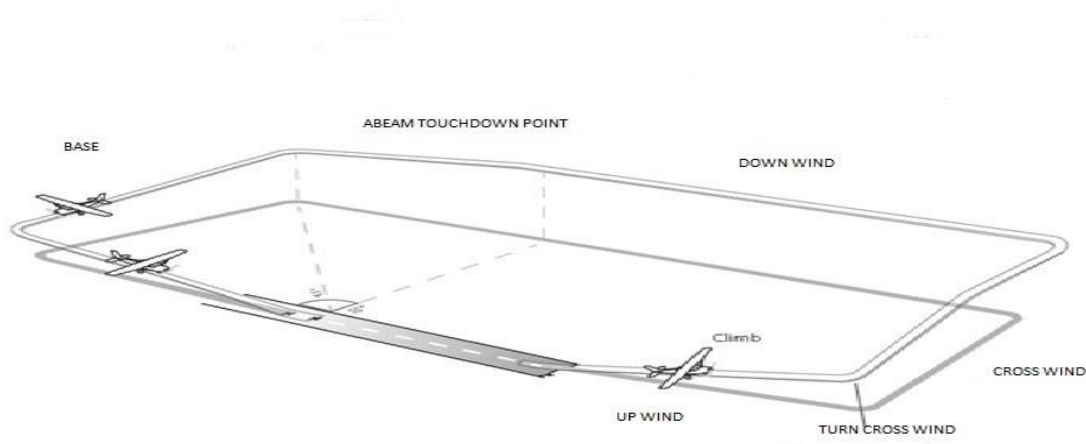


Fig: 1 Left Turn Circuit and Landing Pattern



Fig: 2 Aircraft in the final halted position



Fig: 3:-Portside wing leading edge near wingtip found damage.

1.2 Injuries to persons.

Injuries	Crew	Passengers	Others
Fatal	Nil	Nil	Nil
Serious	Nil	Nil	Nil
Minor/ None	Nil/02	Nil	Nil

1.3 Damage to aircraft.

The aircraft received following Minor damages;

- (a) Leading edge of Fin at the attachment of Beacon found damaged.
- (b) Rudder tip found damaged.
- (c) Tail cone bottom surface found wrinkled.
- (d) Port wing leading edge near wing tip found damaged.
- (e) One side propeller blade found bent inward (approx. 15-20 degrees)
- (f) VHF antenna found broken.
- (g) LH inboard lower wing skin wrinkled at rear spar.
- (h) LH wing leading edge skin outboard at wing tip found cracked and buckled.
- (i) LH wing tip found cracked.
- (j) Fuselage bottom tail cone wrinkled.
- (k) Top of fin skin buckled and damaged.
- (l) Beacon assembly at the top of the fin found damaged.
- (m) Rudder cap assembly found damaged.

- (n) RH wing bottom skin at the inboard side found wrinkled at rear spar.
- (o) VOR antenna located on the fin found damaged.
- (p) RH wing tip found cracked and damaged
- (q) RH leading edge near wing tip paint found chipped.
- (r) Propeller one end of the blade found bent from mid section.

1.4 Other damage.

NIL.

1.5 Personnel information:

1.5.1 Assistant Pilot Instructor:-

Gender: Male

Age: 30yrs(approx.)

License: CPL Holder

Date of Issue: 24/11/2008

Valid up to: 23/11/2013

Endorsements as PIC: Cessna 152 A

Other Endorsements: P-68TC, C-172 R

AFIR Date of Issue: 27/06/2011

Valid Up to: 27/02/2014

Medical Examination:05/02/2013

Medical examination valid up to: 04/02/2014

Total flying experience: 1200 Hrs.

Experience on type: 800 Hrs.

Total flying experience during last 90 days: 119:35Hrs.

Total flying experience during last 30 days: 55:00Hrs.

Total flying experience during last 07 Days: 10:45Hrs.

Total flying experience during last 24 Hours: 01:55Hrs.(incl. Inci. Flights of 8 mins.)

1.5.2 Student Pilot

Gender: Male

Age: 26yrs(approx)

Student License Valid up to: 12/04/2017

Category: Aero plane

Class: Single Engine, Land.

Endorsements: Cessna 152 A

Medical Examination: 06/03/2013(Class-II)

Valid up to: 05/03/2014

FRT0 Valid up to: 19/09/2022

Total flying experience:

Dual : 11:35Hrs. (Approx.)

Solo: NIL

As per the Dossier of the Student pilot, following has been observed;

1. He started his flying activity from 04/10/2012.
2. His monthly flying activity was less. i.e. approx. 2days in a month and approx. 1Hr.24min of flying in every month and also there was no flying activity between Feb.2013 to May 2013.
3. On 06/06/2013, he was subjected for periodical checkup of start-up, taxi, T/o and circuit pattern by Chief Flight Instructor (CFI) and observed that he need to work on approach and flare.
4. On 07/06/2013, during dual flight of circuit& landing exercise by API, he observed that the student pilot needs practice on approach and landing.
5. On 12/06/2013 dual flight of circuit and landing was carried out which ended within 20min. of flying with the incident during their second circuit and landing.

1.6 Aircraft information:

1.6.1: Airframe:-

Certificate of Airworthiness valid up to 22/07/2013. Aircraft completed total airframe hours of 25547:50Hrs and 1215:30Hrs since issuance of last Certificate of Airworthiness.

Cessna FA152 aircraft is a modified version of model 152 which is a high-wing mono plane of all metal semi monocoque construction. The aircraft is equipped with fixed tubular spring steel main gear struts and a steerable nose gear. The nose gear has an air/hydraulic fluid shock strut. Two place seating is standard and a double width fold-up auxiliary seat is optional.

The aircraft is equipped with differential ailerons that move through 20 degrees upwards and 15 degrees downwards. It has single-slotted flaps which are electrically operated and deploy to a maximum of 30 degrees. The rudder can move 23 degrees to either side and is fitted with a ground-adjustable trim tab. The elevators move up through 25 degrees and down through 18 degrees. An adjustable trim tab is installed on the right elevator and is controlled by a small wheel in the center of the control console. The trim tab moves 10 degrees up and 20 degrees down relative to the elevator chord line.

This aircraft is equipped with fixed landing gears. The nose wheel is connected to the engine mount and has a strut to absorb normal operating loads. The braking system consists of single disc brake assembly fitted to the main undercarriage and operated by a hydraulic system. Brakes are operated by pushing on the top portion of the rudder pedals. It is possible to use differential braking when taxiing and this allows very tight turns to be made.

Dual controls are installed on the aircraft.

1.6.2.: Engine:-

The aircraft is powered with single engine (Lycoming 4 cylinder), O-235-N2C (Sl. No. RL-15693-15) normally-aspirated, direct drive, air cooled and horizontally opposite, carburetor equipped engine. The engine has a Horsepower rating of 108 BHP with engine speed of 2550 RPM.

The details are as follows

- Engine Type : LYC.O-235N2C
- Engine SL. No. : RL-15693-15
- Date of Manufacture : 03/02/2012
- Engine T.S.N. in hrs : 1526:40
- Engine T.B.O : 2400 hrs/12 Yrs

The MPFC purchased the re-built engine from manufacturer (Lycoming) with 00.00 hrs (re-built engine purchased from manufacturer is considered as new engine) and installed on 08/04/2012.

Engine Cylinder & Piston Rings:-

Engine cylinders are of conventional air-cooled construction with the two major parts, head and barrel, screwed and shrunk together. The heads are made from an aluminium alloy casting with a fully machined combustion chamber. The barrels, which are machined from chrome nickel molybdenum steel forgings with deep integral cooling fins, are ground and honed to a specified finish.

Pistons are machined from an aluminium alloy. Two compression rings and oil (regulating) ring are employed. The piston pin is of the full floating type with a plug located at each end to prevent the pin from touching the cylinder wall.

Engines are cooled by air pressure actuated by the forward speed of the aircraft. Close fitting baffles build up a pressure and force the air through the cylinder fins. The air is then exhausted through gills or augments tubes usually located at the rear of the cowling.

Full pressure wet sump lubrication system is actuated by an impeller type oil pump contained within the accessory housing.

Dual ignition is furnished by two magnetos.

The aircraft is fitted with all metal fixed pitch sensenich Propellers with 2 blades. There are two doors, one each for both the seats.

1.6.3 Aircraft Maintenance Details:

Aircraft S.No. : FA152-0400
Year of Manuf. : 1985
Engine Type : Lycoming O-235-N2C
Serial No : RL-15693-15 (Rebuilt by M/s. Lycoming on 03.2.2012)
CofR : 24/09/1986 (Initial)
Cof R valid till : 31/03/2014
Usual Station : Indore
Cof A valid up to : 22/07/2013
Category & Sub division : Aerobatic & Passenger
Max. AUW : 760Kgs.
ARC Expires on : 22/07/2013
Aircraft Hours since New : 25547:50
Total time since C of A : 1215:30
Engine Hours since new : 1526:40
Propeller Installed : Sensenich Model No, S72CK56-0-54 Sl.No. K10240
Propeller Hours since new : 1526:40

Last Radio 180days inspection carried out on 10.06.2013 at 25543:51A/F Hrs.

Last Major inspection carried out: check IV / 200Hrs insp. At 25473:30Hrs (TSN) on 23.05.13

The following Last Major scheduled inspections were carried out as a part of maintenance work:

Inspections details	On	at A/F Hrs.
Check I/25Hrs.	11/06/2013	25543:55
Check II/50Hrs.	04/06/2013	25519:55
Check IV/200Hrs./ 1year. &SIP No.55-11-01 & 55-41-01	23/05/2013	25473.30
Check III/100Hrs./ 06months & SIP No.55-11-01 & 55-41-01	06/05/2013	25377:55

As per the Lycoming Mandatory Service Bulletin No.480E engine oil and oil filter to be replaced at every 50Hrs. and accordingly, Aircraft Maintenance Program issue2 Rev.0/ Dt. May2013, devised such that at every 50Hrs. engine oil to be replaced and every 50Hrs/ 04months, engine filter to be replaced.

As per the Aircraft & engine log book records, on 04/06/2013 at 25519:55TSN (Airframe hours) & 1497:45TSN (engine hours), during 50Hrs. Inspection, engine oil replenishment was carried out. However, while scrutinizing the Journey Log Book, it has also observed that for oil & fuel availability for each sector, on 04th June 2013, only 0.4 litre

of oil found recorded under oil uplift column and which is tallying with computerized stock register maintained at store.

As per the journey log book, last total oil replenishment of 6.0lts was carried out on 23/05/2013 and subsequent to that only oil topup activities were found noticed as listed below.

Date	As per the aircraft JLB record.		As per the Stock register
	Total Oil upliftment	Total Flying Hrs.	Total oil upliftment
23/05/2013	6.5	00:45	6.5
24/05/2013	0.3	05:40	0.3
25/05/2013	0.2	03:00	0.2
26/05/2013	--	--	--
27/05/2013	0.2	04:45	0.2
28/05/2013	0.2	02:25	0.2
29/05/2013	0.3	04:55	0.3
30/05/2013	0.2	03:40	0.2
31/05/2013	0.2	02:10	0.2
01/06/2013	0.2	05:30	2
02/06/2013	0.2	02:35	0.2
03/06/2013	0.4	06:20	--
04/06/2013	0.4	07:00	0.4
05/06/2013	0.4	07:40	0.5
05/06/2013	0.1	01:00	
06/06/2013	0.2	04:05	0.2
07/06/2013	0.2	04:45	0.2
08/06/2013	No flying	--	--
09/06/2013	Nil	01:15	--
10/06/2013	0.2	02:55	0.2
11/06/2013	0.2	03:35	0.2
12/06/2013	Nil	00:20	--

As per the JLB, On 04/06/2013, followings are the details of flying activities of the aircraft.

A/F hours logged till previous day ie.03/06/2013 was 25515Hrs.15mins. and Engine Hours 1183Hrs.00mins.

On 04/06/2013	Flying time	Ground time from previous flying	A/F hours on completion of every sortie after 03/06/2013	Engine hours on completion of every sortie after 03/06/2013
08:00 to 11:05	0305	---	25518:20	1186:05
1125 to 1210	0045	20mins.	25519:05	1186:50
1250 to 1340	0050	40mins.	<u>25519:55</u>	<u>1187:40</u>
17:20 to 18:00	0040	03Hrs.40mins.	25520:35	1188:20
18:00 to 18:40	0040	---	25521:15	1189:00
20:00 to 21:00	0100	01Hr.20mins.	25522:15	1190:00

As per log books, check II/ 50Hrs. inspection was carried out between 1340IST to 1720IST on 04/06/2013 (which includes aircraft preparation time for next release also.)

Also, it has been observed that except on 04/06/2013 50Hrs. scheduled maintenance work activity (which was due at 25523:30 airframe Hrs.), all other 50hours inspection scheduled were found carried out only on completion of flying activities on that day or after completion of the above inspection only, the aircraft got release for operation on that day.

During subsequent flying also till the time of occurrence, only topping up of engine oil was found recorded.

Also, as per the record, on 04/06/2013, during 50Hrs. Inspection, new spark plugs were installed and on 11/06/2013, during 25Hrs. Inspection, all spark plugs were cleaned.

As per aircraft Journey Log Book on, 11/06/2013 i.e. one day prior to the incident, the pilot made the entry as RPM Haunts under Pilot Special Report. As a rectification action on 12/06/2013 i.e. before first flight of the day, AME removed tachometry drive shaft, lubricated and installed back. Engine ground run carried out and found satisfactory.

1.6.4 Engine health monitoring records:

As per Engine parameter Register, the parameters under monitoring during each scheduled check are Static RPM, Oil Pressure, Oil Temperature, Cylinder Compression, Condition of Spark Plugs, Condition of Oil Filter, Condition of Fuel Filter, Fuel Consumption, and Oil Consumption. The same has been examined and it is observed that all the parameters were within the limits.

1.7 Meteorological Information

As per Met report issued at 1230UTC and at 1300UTC, Weather conditions at Indore; visibility 4000 meters, winds CALM, QNH 1000HPA, Temp 27Deg.C.

Under special VFR condition, circuit and landing was conducted.

1.8 Aids to Navigation

The sortie was local circuit and flying exercise. All aids were found in serviceable condition.

1.9 Communications

Always the aircraft was in contact with ATC, Indore and communication systems were functioning normally.

As per ATC Tape Transcript, on 12/06/2013, at around 1244UTC aircraft got airborne for its first dual flight. At 1249UTC, the aircraft reported on final and requested for touch and go. Accordingly, ATC, Indore gave permission for touch and go exercise on Rwy25. At around 1250UTC, the aircraft asked for short circuit and would report ATC on final, for which ATC has acknowledged and conveyed the crew to take all necessary precautions. At 1252UTC, Indore ATC called VT-EMU and no response received. At 1253UTC, VT-EUF (Another aircraft of MPFC) called Tower and asked the position of VT - EMU. ATC then informed that, aircraft had crashed near isolation bay.

1.10 Aerodrome Information

Devi Ahilyabai Holkar Airport, Indore, Madhya Pradesh is AAI controlled airport located in Indore & at the elevation of 1850 from MSL. Its coordinates are 22°43'18''N 75°48'03''E. Airport has one runway of 07/25 which is 9022ft long. It has proper controlled tower with ground and tower frequencies. Airport is equipped with VOR/DME/NDB navigational aids.

1.11 Flight Recorders.

The aircraft is not required to equip with the CVR and DFDR as per the existing regulations.

1.12 Wreckage and Impact Information.

None of the major components of the aircraft has been detached from the fuselage. Complete wreckage was found in one place at point latitude 22°43.035'N, longitude 75°47.984'E and at elevation of 564m from sea level. The final position/direction has been shown in fig. 4. From the ground marking, it is observed that the aircraft first made contact on the cultivatable land outside the airport boundary wall at around 105mtrs from the perimeter wall of Indore airport abeam of isolation bay. After the first contact, it had rolled for approx. 99mtrs towards the wall at an angle of 60Deg. (w.r.t airport boundary wall) & came to final halt in toppled position. The distance from the perimeter wall to the final halted position was 5.8mtrs. (Approx.). It is also observed that just before the final halted position, the aircraft got toppled down because of loose soil.

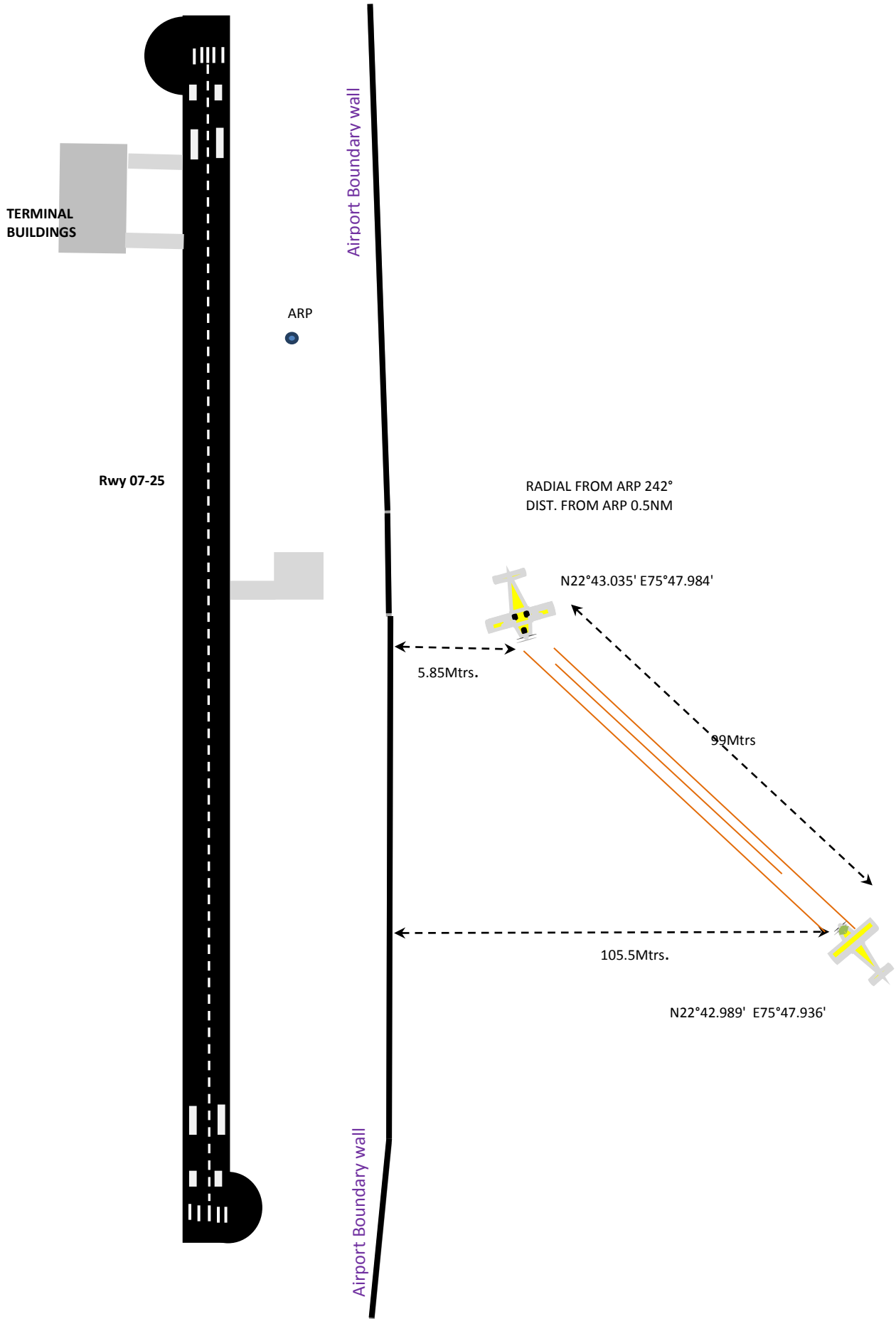


Fig: 4 Sketch of incident site with reference to the Airport (not to scale)

1.13 Medical and Pathological Information.

After the incident, both the Crew had undergone medical examination at Maharaja Yeshwantrao Hospital, Indore. The test results reflected that both of them were not under the influence of Alcohol.

1.14 Fire

There was no fire.

1.15 Survival Aspect.

The incident was survival. No search and rescue was required as the aircraft carried out forced landing just outside the airport boundary wall on Rwy07 side. The instructor and trainee pilot came out of their own from the aircraft without any injury.

1.16 Organizational and Management Information.

MPFC (M.P Flying Club) is a Director General of Civil Aviation (D.G.C.A.) approved Flying Training Institute, conducting comprehensive training for issue of Commercial Pilot License, besides other flying licenses. MPFC was set up in Oct 1951. From 1958 to 1982 the club was maintained and operated by M.P State Govt. The institute has two bases (Bhopal and Indore) and has a total of 09 aircraft which includes Cessna –152/A, Cessna – 172R and Multi engine six seater aircraft P-68C-TC and Baron G58. The training school has got an approved maintenance base at Indore and Bhopal for carrying out maintenance activity as per CAR 145.

1.17 Tests and Research.

1.17.1 Fuel and Oil Sample Report.

As per the fuel examination report, there was no abnormality found in the fuel sample and it passed all the specification tests.

As per the oil examination report received, the lubrication oil sample had not passed the specification requirements for appearance and ash content. The report stated that the sample did not meet the specification requirement and this variation may be due to oil oxidation and service operational reason or from extraneous solids such as dust and dirt.

1.17.2 Strip Analysis of Engine

The involved engine was subjected for detailed strip examination at Varman Aviation Pvt. Ltd, Bangalore;

The salient features of the report are as follows:

A. Insitu' observations:-

- a) Crankshaft could be rotated roughly by 180° only and full rotation was not possible as there was restriction. Hence the engine could not be taken for test on test bed. Also there was no abnormal noise during the half rotation of the crankshaft. Also Magneto timing could not be checked out because crankshaft was not free to rotate. (After removal of cylinder No.3 the engine was found rotating freely.)
- b) The spark plugs were removed from all the four cylinders and visual inspection was carried out and found heavy carbon deposits on three bottom spark plugs and particularly more on No. 3 cylinder bottom spark plug.

B. Bench check:

- a) Bench Check of the Starter & Carburetor performance on fuel test rig was carried out and found satisfactory.
- b) All the eight spark plugs were subjected to BOMB test for ascertaining the firing pattern. The test revealed that the bottom three spark plugs condition was found not satisfactory. However No.1 bottom spark plug and four top spark plug was found satisfactory.
- c) Magnetos were also subjected for bench check and found working normally.

C. Visual examination of internal components:-

- a) Visual inspection of pistons were carried out and followings were the observations:-
 - i. High amount of carbon deposit was found in the ring grooves of Piston No. 3 as compared to other three pistons.
 - ii. Carbon deposits noticed on dome of the Piston.
 - iii. No detonation sign was found on all the pistons.
 - iv. Piston rings were found in stuck position on No. 3 piston without any movement and badly corroded. Blockage of oil ring passage was also witnessed.
 - v. No.3 piston's Piston ring no. 2 was found to be flushed with piston wall inside the groove with no end clearance and also Ring no. 1 & 3 were found flushed with piston wall on one half and protruded on the other half.
- b) Visual Inspection of crankshaft and connecting rod bearing were carried out. No abnormal wear out or scuffing of bearing was found.

- c) Visual and dimensional inspection carried out for all parts and found satisfactory except for pistons, all intake valves, exhaust valve, tappet body and connecting rod bushing.
- d) After removal of cylinder No.3 the engine was found rotating freely. Heavy corrosion was noticed in No. 3 cylinder bore and the rings of the piston. The piston rings were also stuck in groove of the piston. The heavy corrosion was noticed on No. 3 cylinder.
- e) Cylinder no. 1, 2 & 4 were removed one by one. All the cylinder barrels (Cylinder No. 1, 2 & 4) were found slightly corroded. Rust was visible in piston rings area, and piston rings were not free to move in the grooves. On cylinder no. 1, second compression ring and oil regulating ring were found almost in line. On cylinder no. 2 & 4 piston rings were in staggered position. Cylinder bore diameter and Piston rings end clearance was found to be within the limits.
- f) The oil flow check was carried out to ensure flow of oil through oil passages and no obstruction to the oil flow. Further the oil passages were also checked for blockage with insertion of a suitable locking wire through the passages and no evidence of any foreign bodies/obstruction was found in the oil passages.



Fig 5: No.3 Cylinder and its Piston rings



Fig 6: Piston dome (Carbon deposits noticed)



Fig 7: No. 3 Cylinder barrel (in corroded condition)



Fig 8: Condition of No.1 piston& its rings



Fig 9: Condition of T(Top) and B(Bottom) Spark plugs after removal

1.18 Additional Information:

a) Student Pilot:-

As per the Student Pilot, on that day, as instructed by the API, he checked the CRS & carried out pre-flight checks under supervision of API. Fuel on board was approx. 45 ltrs in each wing tank. They were going on a flying sortie and the exercise was circuits and landings.

After the permission from the ATC, he carried out the pre-startup checks. Before taxi, they did the run up checks including magdrop check and static rpm check and were found within normal limit.

Student Pilot taxied the aircraft to Rwy 25, after lining up he carried out pre take off checks (vital checks). Aircraft took off & performed complete circuit pattern and made uneventful landing. During the sortie, he did all the checks in various stages of the circuit pattern and all the parameters were observed normal.

Instructor requested to Indore ATC for a touch and go exercise and after permission from ATC, student pilot carried out take off for second circuit & he noticed that all the engine parameters were within normal limits. Hence, he continued the climb on upwind leg maintaining air speed of 65 knots and at about 200 feet above the ground, he retracted the flaps after checking positive rate of climb. He turned on the cross wind and while climbing on the cross wind leg at approx. 2200ft. He heard a noise and vibration from the engine followed by sudden power loss as well as loss of height. At this point the instructor took over the controls of aircraft immediately.

The instructor did an emergency forced landing on the open field and while trying to stop the aircraft, the aircraft toppled. Both came out of the aircraft safely after securing the aircraft.

b) Assistant Pilot Instructor (API):-

As per the API, he was carrying out training flight with Student Pilot. Weather conditions at Indore were visibility 4000 meters, winds NW 05 kts. (approx.) Under special VFR, Circuit & Landings exercise was conducted. Before taxiing out they did all the run up checks including mag drop & static RPM checks which were satisfactory & within limits. Carried out one complete circuit and landing during which all parameters were normal. Second circuit of touch and go was planned.

Student was carrying out the takeoff during which he observed engine was on max power and all the parameters were normal. The incident took place when they were in a climb on the crosswind leg at approx. 2200 feet (MSL), heard abnormal noise from the engine followed by vibrations and complete power loss. At this point, he (API) took over the controls of the aircraft and turned the aircraft towards the Runway. He tried to recycle the throttle in order to regain power in the air, but there was no response.

As he realized that he is unable to reach the Airfield, he selected an open field for emergency force landing. For securing the engine in flight, he put the mixture control to cut off position and carried out approach on the selected field. Aircraft landed on the main wheels first and then nose wheel settled on the ground & used brakes to stop the aircraft. When the aircraft was about to stop, the nose wheel mired in soft soil and the aircraft toppled. The Instructor secured the aircraft and both of them came out from the aircraft safely.

Instructor further stated that he checked the oil pressure and Temperature gauges and which were registering normal. As he thought that it could be due to fouling of spark plugs, he recycled the throttle in order to regain the power. But engine did not respond. Due to lack of time & height he secured the engine by cutting the mixture and he carried out forced landing. After the aircraft came to the complete halt, he continued with the engine securing procedure i.e. Ignition OFF, Master OFF and Fuel shutoff valve OFF.

During the approach phase, he was unable to do the RT call. After landing, he called up the air traffic controller on ATC landline and reported them about the emergency force landing due to engine power loss and requested for appropriate safety services. Also he reported the same to The Madhya Pradesh Flying Club.

c) Aircraft Maintenance Engineer (AME):-

As per the AME, he completed the daily inspection schedule and started following checks as per the daily inspection procedure sheet and issued CRS at 7:00Hrs. on the day of incident.

Further he has stated that a special report of "RPM hunting" was raised by the pilot on 11/06/2013, to rectify the snag he removed the tachometer drive shaft, cleaned, lubricated and installed back. Drive shaft checked for absence of kinks, dents and sharp bends this rectification work carried out along with daily inspection schedule. The engine was given ground performance and all parameters found satisfactory. After satisfaction, he issued CRS and briefed the pilot instructor about the rectification work performed on the special report raised by the crew.

d) Air Traffic Controller statement:-

Air Traffic Controller stated that he observed C152 aircraft, regn. VT EMU belonging to M/s MPFC, during circuit & landing was falling in the open field outside perimeter wall of airport near isolation bay. He immediately pressed the crash siren & fire bell and informed fire station on walkie-talkie to proceed on site and take necessary action.

e) ATC Log Book:-

As per ATC log book at 1252UTC, VT – EMU, C152 trainee flight of M/s MPFC, during circuit landing in the left hand downwind RWY 25 was falling in the open field outside perimeter wall of airport near isolation bay. Immediately pressed the crash siren and fire bell and informed fire station on walkie talkie to proceed on site and take necessary action.

At 1253 UTC crash fire tender and ambulance proceeded on site and reached at 1254 UTC and did the needful for prevention of any further miss happening.

At 1255 UTC PIC of VT-EMU informed to tower on landline that aircraft did an emergency landing in the field due to engine failure and both instructor and trainee are safe.

Incident informed to all concerned and advised the CISF to secure the accidental site.

f) POH Guidelines for Forced Landings (Emergency Landing without Engine Power):-

1. Seats, Seat Belts, Shoulder Harnesses – SECURE.
2. Airspeed – 65Kts (Flap UP)
60Kts (Flaps DOWN)
3. Mixture – IDLE CUT-OFF
4. Fuel Shutoff Valve – OFF
5. Ignition Switch – OFF
6. Wings Flaps – AS REQUIRED (30° Recommended).
7. Master Switch – OFF
8. Doors – UNLATCH PRIOR TO TOUCHDOWN
9. Touchdown – SLIGHTLY TAIL LOW
10. Brakes – APPLY HEAVILY.

1.19 Useful or Effective Investigation Techniques used

NIL.

2. ANALYSIS

2.1. Operational Aspect:-

The aircraft was released by AME after carrying out daily inspection at Indore at 0700 hrs on 12/06/2013 with adequate fuel and oil onboard. Dual flight was planned for local circuit and landings by the instructor. At around 1230 UTC, trainee pilot under the supervision of API, carried out pre-start and start-up checks. During that time Fuel on board was approx. 45 litres in each wing tank and 6 litres of engine oil was onboard which was sufficient to carry out the planned circuits.

The aircraft got airborne at around 1244 UTC and at around 1249UTC, performed the first circuit pattern successfully. During the first sortie they did all the checks in various

stages of circuit pattern and all the parameters were found normal. During their first circuit, on final touch and go, request was made by the aircraft for their second short circuit and landing exercise. Accordingly, ATC Indore granted the permission for the same and told them to take all necessary precautions.

Under the supervision of instructor, the student pilot carried out touch and go for the second circuit (Left circuit pattern) and observed engine all parameters were normal. The student pilot continued the climb on upwind leg maintaining air speed of 65 knots and at about 200ft above the ground, after confirming positive rate of climb, flaps were retracted. When they were in a climb on the crosswind leg at approx. 2200ft, heard abnormal noise from the engine followed by vibrations and complete power loss. At this time, the instructor pilot took over the controls of the aircraft and turned the aircraft towards the runway. He checked oil pressure and temperature and found normal and recycled the throttle in order to regain power, but, as there was no response, the instructor then selected an open field for emergency force landing and carried out forced landing.

During the forced landing phase, he put the mixture control to cut off position and carried out approach on the selected field. Aircraft landed on the main wheels first and then nose wheel settled on the ground and crew used brakes to stop the aircraft. As the aircraft was about to stop, the nose wheel mired in soft soil and the aircraft toppled.

Due to lack of time & height he secured the engine by cutting the mixture only while he carried out forced landing. After the aircraft came to the complete halt, he carried out engine securing procedure i.e. Ignition OFF, Master OFF and Fuel shutoff valve OFF.

During the approach phase, he was unable to make the RT call. Only after landing he called air traffic controller on landline and reported them about the emergency force landing.

As per the crew, they did not observe or experience any problem during their first sortie. Further as they heard abnormal noise and total power loss and throughout the phase there were no procedural lapses observed during their operation. Probably, there could be some defect with aircraft and nothing to suspect by the operational point of view except the non-compliance of few emergency forced landing procedure (without engine power)after the incident.

2.2 Weather Aspect:-

As per Met report issued at 1230 UTC and at 1300 UTC, Weather conditions at Indore; visibility 4000 meters, winds CALM, QNH 1000HPA, Temp27⁰C. The Weather prevailed at the time of occurrence was normal and there was no high wind and ideal to carry out VFR flight. Since, the instructor is authorized to carry out operation under special VFR condition, hence weather was not considered as a contributory factor on this incident.

2.3 Maintenance Aspect:-

The aircraft was issued with certificate of airworthiness on 11/07/2008 and was valid till 22/07/2013.

There was a special report raised on 11/06/13 at 1155 hrs. (i.e., one day prior to the incident) by the pilot i.e. "RPM Hunting" other than that no other snag found or reported by the crew or AME. To clear special report, AME removed the tachometer drive shaft, cleaned, checked for absence of kinks, dents and sharp bends and found no abnormality. He installed back the same after lubrication. Subsequently, he did engine ground run during which the performance of the engine and all parameters were observed satisfactory. The AME cleared the special report with NIL entry on 12/06/2013, with CRC on completion of DI inspection with validity till 07:00 Hrs on 13/06/2013 or 12 Flying Hours from the date of issuance of certificate whichever is earlier with adequate fuel and oil onboard.

As per the records, it has been observed that there were new sparkplugs found installed and oil replenishment was taken place just couple of days back. On 11/06/2013, again, sparkplugs were cleaned and refitted as part of scheduled inspection.

After taken over for flying activity by the flying crew, the aircraft was subjected for all operational check and found nil observation. Subsequently, the aircraft had successfully completed its first circuit and landing exercise and no malfunction of systems or controls nor any snag / abnormalities were observed by the crew. Hence, they continued for the second circuit and landing exercise.

From the fuel and oil samples result from AED Dte., of DGCA, India, it has been observed that fuel sample passed all the specification tests. However, the lubrication oil sample had not passed the specification requirements for appearance and ash content. The report stated that the sample did not meet the specification requirement and this variation may be due to oil oxidation and service operational reason or from extraneous solids such as dust and dirt.

This denotes that there are some problem noticed in the engine oil especially appearance and ash content. This further hinted that as the oil is being used for engine and its components for lubrication purpose, ruling out of engine and its components is not possible.

This indirectly indicates that as there is oil replenishment and sparkplug replacement or cleaning is supposed to be carried out during their routine Line Maintenance activity and as there are some discrepancies in the maintenance records, probably, it can be concluded that a) engine detailed analysis and b) cross checking of line maintenance activity records in detailed could reveal the most probable cause of the incident. Accordingly, engine was sent to Varman Aviation Private Limited for detailed investigation.

2.4 Engine Strip Analysis:-

The suspected engine was analyzed at VAPL, Bangalore and it has been observed that;

During insitu' inspection, propeller could not be rotated fully as there was some restriction noticed. Engine could not be tested on the test bed as the engine was not able to rotate. There was an abnormal noise during the half rotation. After No.3 piston was removed, crankshaft was found rotating freely. All the 8 spark plugs were inspected and found heavy carbon deposits on three bottom spark plugs and particularly more on No. 3 cylinder bottom spark plug. Bottom cylinder No.1 sparkplug found with oil and carbon deposit. All the eight spark plugs were subjected to BOMB test for ascertaining the firing pattern. The test failed for the bottom three spark plugs. However No.1 bottom spark plug and four top spark plugs passed the BOMB test satisfactory.

After removal off no.3 piston, the crankshaft was free to rotate and subsequently other pistons were removed. During engine strip analysis, it was observed that heavy corrosion was noticed in No. 3 cylinder bore and the rings of the piston. The piston rings were also stuck in groove of the piston.

Engine was disassembled and found that no physical damage inside the engine and gears were observed. All other systems were found working properly and remaining engine components were found within permissible limits. Bench Check of the Starter & Carburetor performance on fuel test rig and Magnetos were also checked and found satisfactory. Oil filter was cut opened and no metal particle was found. The engine test report has given following findings:

A. Probable cause for carbon deposits on spark plugs could be due to;

- a) Use of unspecified fuel.
- b) Lead fouling of spark plug due to low power operation of the engine which lead to weak spark and ultimately inefficient burning of charge inside the cylinder.
- c) Burning of oil with the charge.

B. Probable cause for absence of lubrication oil:

Cylinder assemblies are lubricated by splash method. Complete absence of oil inside cylinder can be attributed to burning of oil due to high Cylinder Head Temperature (CHT) during operation leading to lack of lubrication in Cylinder No. 3.

- a) High CHT due to lean charge in the cylinder No. 3 due to air leakage would have burnt lubricating oil inside the cylinder creating a deficiency of lubrication and seizure of piston.

- b) Improper cooling of cylinder No.3 leading to high Cylinder Head Temperature (CHT) and resulting in lack of lubrication and seizure of piston in the cylinder No.3.
- c) Heavy carbon deposit in the piston ring grooves of piston no. 3 would not have allowed lubricating oil to enter properly inside and this would have caused seizure of piston in the cylinder.

The report has concluded that;

- i. Due to heavy carbon deposits on the bottom spark plugs of three cylinders (Cylinder No. 2, 3& 4), the spark plugs would have produced low intensity spark resulting insufficient burning of charge inside the cylinder.
- ii. Lack of lubrication lead to the seizure of the piston rings. The Lack of lubrication could be due to overheating of the No. 3 cylinder because of lack of cooling of the Cylinder head and barrel and/or due to supply of lean mixture to No.3 Cylinder due to external air leakage to the cylinder which can occur at the joint face of air/fuel mixture intake pipe and to No. 3 cylinder.

It is therefore, inferred that due to the above reasons the engine would have lost the power completely.

Also as per DGCA R&D lab examination on fuel and oil samples, the oil sample report stated that the sample did not meet the specification requirement and this variation may be due to oil oxidation and service operational reason or from extraneous solids such as dust and dirt.

As per the maintenance schedule records, it appears that the aircraft was properly maintained by the organization by complying all the scheduled inspection like 25 hrs, 50 hrs, 100 hrs, 200 hrs, 400 hrs before due date. However, as per the Journey log book entry and stock register record, observed that the oil replenishment was not carried out under 50Hrs.scheduled maintenance prog,

From the above, it is concluded that most probably, the oil replenishment was not carried out as per the requirement which has led to heavy carbon deposit on the spark plugs which has resulted insufficient burning of charges inside the cylinder and lack of lubrication lead to seizure of the no.3 piston in the cylinder has resulted the power loss of the engine.

3. CONCLUSION:

3.1 FINDINGS:

1. The certificate of airworthiness was valid at the time of incident.
2. The aircraft was released for dual flight with nil snag on that day.
3. Adequate fuel and oil were available before and after the incident.
4. Both the instructor and the student pilot were appropriately licensed.
5. After getting airborne, during crosswind climb at approx. 2200ft, crew experienced abnormal noise followed by vibration with complete power loss.
6. Since restart of the engine was unsuccessful, instructor carried out emergency forced landing in an open area.
7. Instructor carried out only mixture cutoff during forced landing and on completion of forced landing, he secured the engine by carrying out Ignition OFF, Master OFF and Fuel shutoff valve OFF.
8. There was no fire/ smoke noticed from the aircraft.
9. Crew was subjected for B.A test after the incident and was not found under the influence of alcohol.
10. As per fuel and oil samples reports, fuel sample passed all the specification tests. However, the lubrication oil sample had not passed the specification requirements for appearance and ash content.
11. All 08 spark plugs were inspected and found heavy carbon deposits on three bottom spark plugs and particularly more carbon deposits on No. 3 cylinder bottom spark plug. Bottom cylinder No.1 sparkplug found with oil and carbon deposit.
12. During engine inspection at vendor facility it was observed that;
 - 12.1 All the eight spark plugs were subjected to BOMB test and the test revealed that the bottom three spark plugs failed in the test. However No.1 bottom spark plug and four top spark plugs were found satisfactory during test.
 - 12.2 On engine disassembly, no physical damage inside the engine and gears was observed. All other systems were found working properly and remaining engine components were found within permissible limits.
13. As per the engine test report, the power loss on the engine could be;
 - 13.1 Due to heavy carbon deposits on the bottom spark plugs of three cylinders (Cylinder No. 2, 3 & 4), the spark plugs would have produced low intensity spark resulting insufficient burning of charge inside the cylinder.
 - 13.2 Lack of lubrication lead to the seizure of the piston rings. The Lack of lubrication could be due to overheating of the No. 3 cylinder because of lack of cooling of the Cylinder head and barrel and/or due to supply of lean mixture to No.3

Cylinder due to external air leakage to the cylinder which can occur at the joint face of air/fuel mixture intake pipe and to No. 3 cylinder.

14. As per the engine test report, the power loss on the engine could be;

14.1. Due to heavy carbon deposits on the bottom spark plugs of three cylinders (Cylinder No. 2, 3 & 4), the spark plugs would have produced low intensity spark resulting insufficient burning of charge inside the cylinder.

14.2. Lack of lubrication lead to the seizure of the piston rings. The Lack of lubrication could be due to overheating of the No. 3 cylinder because of lack of cooling of the Cylinder head and barrel and/or due to supply of lean mixture to No.3 Cylinder due to external air leakage to the cylinder which can occur at the joint face of air/fuel mixture intake pipe and to No. 3 cylinder.

15. As per Journey log book and stock register, there were only oil topup activities were noticed during the last 50 Hrs inspection schedule instead of total oil replenishment.

3.2 Probable Cause:

The most probable cause for the incident was due to total oil replenishment which was not carried out as per the 50Hrs. approved schedule and only topping up of engine oil was carried out which has lead the engine oil properties to change significantly and in turn for heavy carbon deposits on the spark plugs. This has resulted insufficient burning of charges inside the cylinder and lack of lubrication which lead to seizure of no. 3 piston in the cylinder routed for loss of power on the engine.

4. Safety Recommendations:

1. Suitable action deemed fit may be taken by DGCA based on probable cause.
2. Appropriate corrective training be imparted to API for not securing engine properly before forced landing.

New Delhi - 3.
04/04/2016


(R.Rajendran)
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