No. : AV.15013/07/2011/AS

REPORT

ON ACCIDENT TO M/S PIONEER FLYING ACADEMY CESSNA-152 AIRCRAFT VT-PSJ AT VILLAGE DHANIPUR, DISTRICT ALIGARH (UP) ON 29/07/2011

AIR SAFETY DIRECTORATE
O/o DIRECTOR GENERAL OF CIVIL AVIATION
OPP. SAFDARJUNG AIRPORT, NEW DELHI

30/5/13

Foreword

This document has been prepared based upon the evidences collected during the investigation, opinion obtained from the experts and laboratory examination of the components and other items. The investigation has been carried out in accordance with Annex. 13 to the Convention on International Civil Aviation and under the Rule 71 of the Aircraft Rule 1937. The investigation is conducted not to apportion blame or to assess individual or collective responsibility. The sole objective is to draw lessons from this accident which may help to prevent future accident or incident.

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REPORT ON ACCIDENT TO M/s PIONEER FLYING ACADEMY CESSNA-152 AIRCRAFT VT-PSJ AT VILLAGE DHANIPUR, DISTRICT ALIGARH (UP) ON 29/07/2011

a)	Aircraft		
	Type	:	Cessna
	Model	:	C-152
	Nationality	:	Indian
	Registration	:	VT-PSJ
b)	Owner/operator	:	Pioneer Flying Academy Pvt. Ltd Chanakyapuri, New Delhi-58
c)	Pilot in command	:	CPL holder
	No. of crew	:	2(two)
	Extent of Injuries	:	Fatal
d)	Geographical Location	:	Paddy field of Village. Dhanipur, District of Aligarh, UP **Coordinates:** N $27^0$51'26.06", E $78^0$09'36.74", Elevation 185m
e)	Date & time of Accident	:	29/07/2011 at 10:00 UTC
f)	Last Point of Departure	:	Dhanipur Airstrip, Aligarh(UP)
g)	Point of Intended Landing	:	Dhanipur Airstrip, Aligarh(UP)
h)	Type of Operation	:	Flying Club/School
i)	Type of Flight	:	Training Flight
j)	Phase of operation	:	Take-off

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

Synopsis

M/s Pioneer Flying Academy Cessna-152 Aircraft VT-PSJ met with an accident while operating a training flight on 29/07/2011 at Dhanipur Airstrip. The aircraft took-off from Dhanipur Airstrip Aligarh with Pilot Instructor In charge (PII) and a trainee pilot on board. After take-off, when the aircraft was at around 200ft-300ft, it transmitted that it was returning back. Thereafter aircraft turned right and simultaneously lost height. Aircraft rapidly lost height and crashed in a paddy field approximately 740 meters from edge of the runway 29 of Aligarh Airfield.

DGCA instituted investigation Under Rule 71 of the Aircraft Rule 1937 by Inspector of Accidents. The Inspector of accidents was replaced during investigation process.

The aircraft impacted a bund of mud approximately 1 meter in height in the paddy field. It came to rest after covering a distance of 10 m. from the bund of mud. Due to the impact, cockpit area of the aircraft was extensively damaged. Both PII and trainee pilot suffered fatal injuries. The propeller of the aircraft separated from the engine along with the mounting bolts and bushes. Accident took place at approximately 10:00 UTC during the day.

Accident occurred due to impact with the ground following a sudden loss of height as crew encountered an abnormal situation. The encountered abnormal situation may be due to loosening of the propeller mounting.

1. Factual Information:

1.1 History of Flight:

On 29.07.2011 after daily inspection the Cessna 152 aircraft VT-PSJ was released for flying at 7:30 UTC. In the Flight authorisation register the flight was authorised by the PII on this aircraft; however details of the exercise to be carried out and location was not mentioned.

Pilot Instructor In charge (PII) started the aircraft at around 09:40 UTC for carrying out a training sortie with the trainee pilot. However he was not able to receive radio transmission made by ground R/T operator. The headset was changed and the aircraft was given clearance for taxy. The aircraft taxied straight ahead and then took a right turn. The aircraft was stopped and switched off on taxy holding point facing the runway. The PII called for the Chief Engineer (CE) on R/T to check the aircraft. As per the Chief Engineer (CE), PII reported some unease in the rudder pedal travel. Then the technician came and towed the aircraft back to the starting point. Thereafter the lubrication of the rudder pedal and cable was carried out by the CE. After that CE told the technician to tow the aircraft on the ground so as to see the movement of the nose wheel operation. The nose wheel operation was checked and was found satisfactory.

Thereafter PII and trainee pilot sat in the aircraft. After starting again, the aircraft was given clearance to taxi. Aircraft took off from R/W 11. PII intimated on R/T that he would be proceeding to sector North at 2000 ft and the same was acknowledged.

After approximately 35 to 40 seconds of getting airborne, PII informed ground R/T operator that he was returning back in a panicked voice. Then he came out of the office and saw the aircraft on take off path with approximate height of 200-300ft trying to turn right. The aircraft was turning and also losing height. On ground, aircraft impacted a bund of mud of approximately 1 meter height in a paddy field. The aircraft moved forward and came to rest at around 10 meters from the bund. The propeller assembly of the aircraft had separated from the engine along with the mounting bolts and bushes before the final resting place of the wreckage. The accident took place at approximately 10:00 UTC during the day time. There was no fire. Besides propeller, nose wheel & left main wheel were found broken and separated from the fittings. Engine area was smashed inside the cockpit.

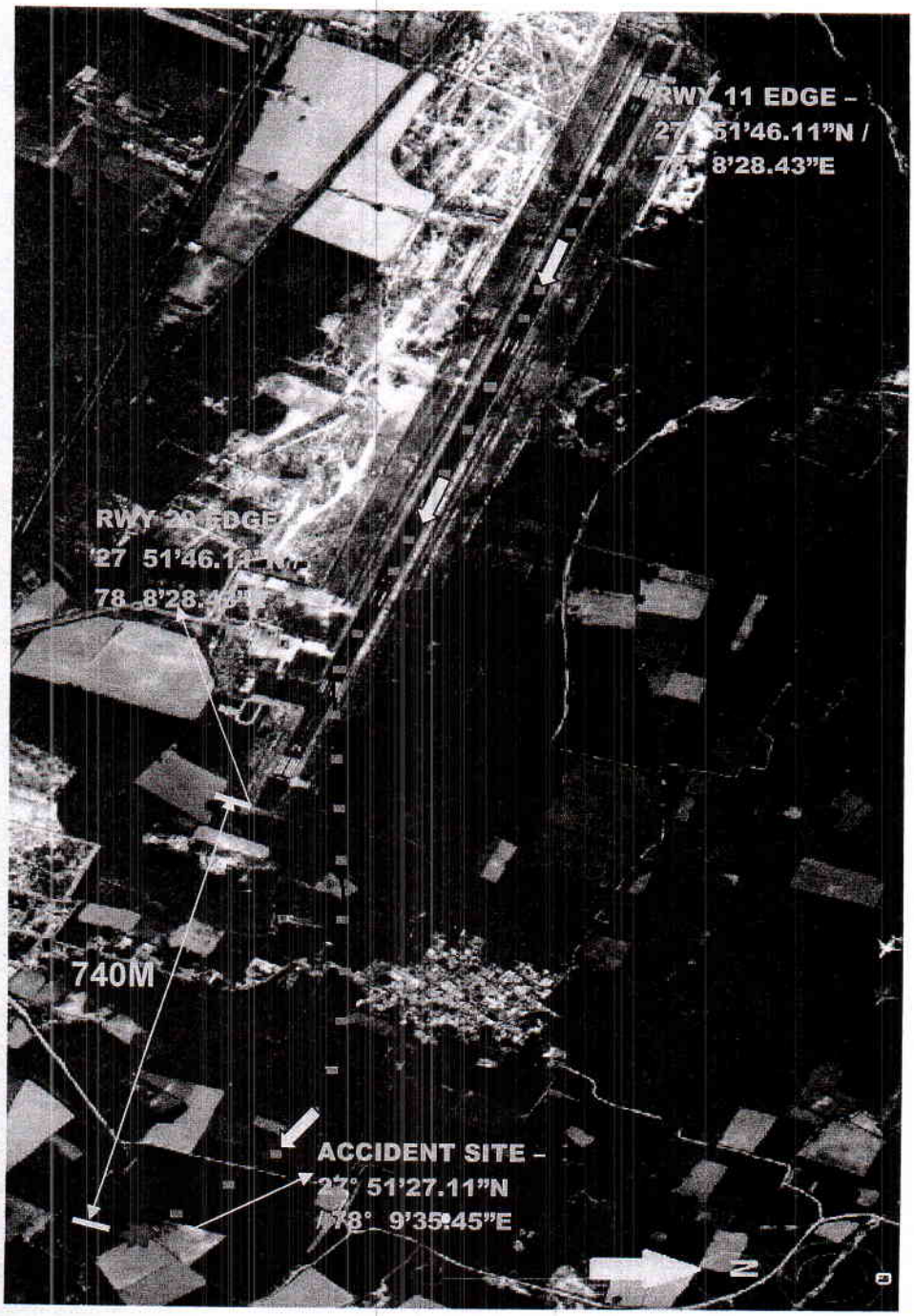


Fig. 1: **Probable Flight path of the aircraft and the location of Crash site.**

Due to collapsing structure both PII and trainee pilot suffered injuries. The villagers who were working in the paddy field ran towards the Aircraft and broke the wind screen, cut the seat belts on the instructions of PII and rescued them from the aircraft wreckage. The PII & trainee were taken to a hospital in Aligarh for treatment. PII was declared brought dead and trainee was hospitalized for treatment. On 02/08/2011, the trainee pilot also died while being transferred to a hospital in Delhi.

1.2 Injuries to Person:

Injuries	Crew	Passengers	Others
Fatal	2	Nil	Nil
Serious	-	-	-
Minor	-	-	-
None	-	-	

1.3 Damage to Aircraft:

Aircraft was substantially damaged.

1.4 Other Damage:

Mud bund used for holding water in the fields was damaged due to the impact of the aircraft.

1.5 Personal Information:

1.5.1 Pilot in Command:

a) License Type	:	CPL
b) CPL Valid up to	:	20/04/2014
c) Date of Initial Issue	:	26/04/1982
d) Date of Endorsement of Cessna 152	:	27/03/1989
e) Date of Birth	:	22/05/1959
f) Date of Last Medical	:	29-04-2011 (Class-I)
g) Medical Valid up to	:	28/10/2011
FRTO valid till	:	20/04/2014. (Initial issue on10/11/1981)
h) Instrument Rating issued on	:	21/01/1994 on Cessana-152 A.
i) Date of last IR /Competency check	:	25/07/2011
j) English Language Proficiency Check	:	Carried out on 22/02/2011 in Level 4 (Valid up to 21/02/2014)
k) **Aircraft Ratings**	:	
As PIC	:	Cessna 152 A, P-68 Observer, Pushpak, Silvaire Luscombe, Cessna 310

l) He was holding Flight Instructor's Rating (Aero) issued on 05/09/2008 and was revalidated on 05/09/2010 up to 04/09/2011.

m) **Flying Details** :

Total flying experience	: 2482.14 Hrs
Total instructional flying experience	: 1853:15 hrs
Flying experience during last 6 months	: 55:45 hrs
Flying experience during last 90 days	: 16:00 hrs
Flying experience during last 1 month	: 03:30 hrs
Flying experience during last 7 days	: 01:00 hrs
Flying experience during last 24 hours	: 00:00 hrs

1.5.2 **Trainee-Pilot**

a) License Type	:	Student Pilot Licence (SPL)
b) SPL Valid up to	:	20/06/2016
c) Date of Initial Issue	:	21/06/2011
d) Date of Birth	:	01/07/1986
e) Date of Last Medical	:	14-12-2010 (Class-II)
f) Medical Valid up to	:	13/12/2011

As per the Flight Authorisation book, he had no flying experience.

1.5.3 **Aircraft Maintenance Engineer**:

Date of Birth	:	18/02/1988
Licence Type	:	AME
Date of Issue	:	10/07/2009
Endorsement	:	Cessna 152 – 27/04/2011
Experience on type	:	03 Months (approx.)
Total Experience	:	05 years 10 month

1.5.4 **Ground Radio Operator**

He holds a current Commercial Pilot's Licence issued by DGCA India. Cessna 152A and 172 are endorsed on his CPL.

Date of Birth	:	25/03/1988
Licence Type	:	FRTOL
Date of Issue	:	18/10/2010
Valid till	:	17/10/2015

1.6 Aircraft Information:

Manufacturer	Cessna Aircraft Company, USA.
Type	Cessna-152
Constructor's S.NO.	15281134
Year of Manufacturer	1977
Certificate of Airworthiness	No. 6060 Date of issue: 17/05/2009 Last C of A issued on 14/12/2010 & revalidated till 14/12/2011.
Category	Normal
Sub Division	Passenger
Certificate of Registration	3951 issued on 23/04/2009
Owner	Pioneer Flying Academy Pvt. Ltd., B-126, Yashwant Place, Chanakyapuri.
Minimum Crew Necessary	01
Maximum All Up Weight Authorised	757. kg
Last Major Inspection	150 Hrs/ 9 Months inspection carried out on 19.06.2011 TSN 7279:05 Hrs
Last Inspection	Daily Inspection Schedule
Air frame Hrs. Since New	7279 :12 Hrs till the time of Accident
Air frame Hrs. Since last C of A	125 :12 Hrs till the time of Accident

Engine	
Manufacturer	Textron Lycoming- USA
Type	LYCO-O-235-L2C
Serial No.	L-17867-15
Hours Done Since New	As per the export C of A issued by FAA the engine hours were 6888.6 Hrs However as per the engine log book maintained by the operator, the engine hours at the time of accident were 4220:25 Hrs.
Hours Done Since Overhaul	390:22 Hrs till the time of accident.
Last Major Inspection Carried out	150 Hrs inspection carried out on 19.06.2011
Last Inspection	Daily Inspection Schedule
Average Fuel Consumption	20 ltrs/hrs
Average Oil Consumption	00.28ltrs/hrs
Propeller	
Manufacturer	SENSENICH
Sr. No.	K-8476
Installed new on	12th July 2003 at 6349.9 Airframe hour
Model No.	➢ As per Export Certificate of Airworthiness issued by FAA the model was 72CK-S6-O-52. Static RPM 2325 ➢ However as per the propeller logbook maintained by the operator the model was 72-CKS-O-54. Static RPM 2300 ➢ As per the POH the model is McCauley Model No. 1A103/TCM6958. Static RPM 2280 to 2380.

Last Overhaul	Not Applicable
Hours since New	929:00 Hrs.

1.6.1 **Scrutiny of record:**

- Scrutiny of Airframe Log book revealed that 150Hrs/9 month inspection schedule was carried out as per the approved schedule at A/F 7279:05 Hrs (TSN) on 19-06-2011.
- From 19-06-2011, the aircraft did not fly, however engine ground run was carried out on 28-06-2011, 07-07-2011, 16-07-2011 & 23-07-2011. On 28-06-2011, 07-07-2011 & 08-07-2011 aircraft was released for flying, however due to bad weather flights could not be undertaken. Therefore the aircraft was on ground for more than 1 month till the day of accident
- Engine installed on the aircraft, was last overhauled (bottom end Overhaul) at "Aero Engines of Winchester, INC, 615, USA on 15th Oct. 2008. In the details of Inspection during overhaul, inspection of the propeller mounting bushes has not been recorded. It was confirmed through FAA that bushes were not replaced during overhaul.
- M/s Pioneer Flying Academy was asked to submit the **release note** of the bushes installed on the engine and details of any inspection/work carried out on the bushes. However same was not provided.
- 200 hours / 1 year inspection schedule was carried out on 03.11.2010.

This inspection schedule contains following inspection items/work on propeller assembly:

- Remove spinner, bolts, bulkhead and propeller.
- Inspect bulkhead holes for crack by magnifying glass.
- Check propeller mounting bolt for condition.
- Check propeller hub, bolt holes for crack visually by magnifying glass.
- Install bulkhead and propeller in correct position. Torque bolt in correct sequence Torque (300-320 in lbs).
- Lock wire the bolt and install spinner.

- All the mandatory modifications of the aircraft were complied with till the day of accident.
- Scrutiny of defect register did not reveal any specific snag on engine & the flight control system of the aircraft during last 6 months. **However on the date of accident, two snags were encountered before take off.** First the headset was found defective and then there was some sluggishness on the control of the rudder. The Aircraft was attended by chief engineer and the defect of sluggishness was rectified by lubricating the rudder pedal at the

apron itself. Both these snags are not mentioned in the Tech log/snag register. As per ground radio operator air was bled from the nose gear oleo strut.

- As per the CRS the daily inspection schedule was carried out on 29-07-2011 and the aircraft was released from 07:30 UTC on 29-07-2011 for flying up to 07:30 UTC on 30-07-2011. The DI schedule includes check on the mag drop and it was found to be 100 on both sides. The Radio CRS was valid till 11-10-2011.

Aircraft had flown during last 6 months : 100:47 hours.
Aircraft had flown during last 3 months : 12:52 hours

1.6.2 Load and Centre of Gravity:

The aircraft had 83 litres fuel in the Fuel Tank and full oil in the oil Tank on board the aircraft before the accident flight. Total all Up Weight and Centre of Gravity of the aircraft was within prescribed limit at the time of accident.

1.6.3 General Description:

The airplane is an all metal, high wing, single engine airplane equipped with tricycle landing gear. The externally braced wings contain fuel tanks. Conventional hinged ailerons and single-slotted flaps are attached to the trailing edge of the wings. The empennage consists of a conventional vertical stabilizer, rudder, horizontal stabilizer, and elevator. The top of the rudder incorporates a leading edge extension which contains a balance weight. The horizontal stabilizer also contains the elevator trim tab actuator. The entire trailing edge of the right half is hinged and forms the elevator trim tab. The leading edge of both left and right elevator tips incorporate extensions which contain balance weights. 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 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. Effective ground control while taxing is accomplished through nose wheel steering by using rudder pedals: left rudder pedal to steer left and right rudder pedal to steer right. When a rudder pedal is depressed, a spring-loaded steering bungee (which is connected to the nose gear and to the rudder bars) will turn the nose wheel through an arc of approximately 8.5° each side of centre. By applying either left or right brake, the degree of turn may be increased up to 30° each side of centre. The wing flaps are of the single-slot type with a maximum deflection of 30°. They are extended or retracted by positioning the wing flap switch lever on the instrument panel to the desired flap deflection position. The switch lever is moved up or down in a slot in

the instrument panel that provides mechanical stops at the 10° and 20° position. For flap setting greater that 10°, move the switch lever to the right to clear the stop and position it as desired. A scale and pointer on the left side of the switch lever indicates flap travel in degrees. The airplane is powered by a horizontally-opposed, four-cylinder, overhead-valve, air-cooled, carburettor engine with a wet sump oil system. The engine is a Lycoming Model O-235-L2C and is rated at 110 horsepower at 2550 RPM. Major engine accessories (mounted on the front of the engine) include a starter, a belt-driven alternator, and oil cooler. Dual magnetos are mounted on an accessory drive pad on the rear of the engine. Engine power is controlled by a throttle located on the lower centre portion of the instrument panel. The throttle operates in a conventional manner; in the full forward position, the throttle is open, and in the full aft position, it is closed. The mixture control, mounted above the right corner of the control pedestal, is a red knob with raised points around the circumference and is equipped with a lock button in the end of the knob. The rich position is full forward, and full aft is the idle cut-off position. For small adjustments, the control may be moved forward by rotating the knob clockwise and aft by rotating the knob counter clockwise. For rapid or large adjustments, the knob may be moved forward or aft by depressing the lock button in the end of the control, and then positioning the control as desired.

Propeller and Spinner:

The propeller assembly consists of spinner cap, Spinner base, propeller rear bulk head, spacer and starter ring gear assembly. The rear bulkhead (or back plate) of the spinner is installed between the propeller and propeller spacer. The propeller and spacer are balances as a unit. The propeller assembly is mounted on the crankshaft flange with six bolts. The bolts are tightened in the flange bushings. The bolts are torqued to 350 inch pounds and safety wire locked.

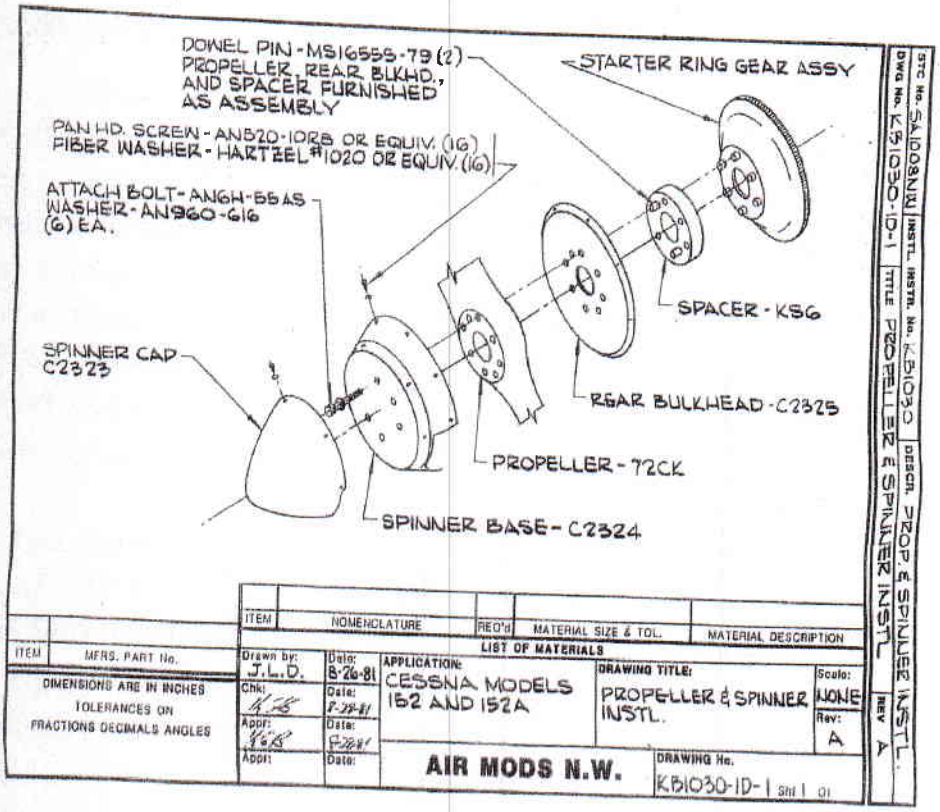


Fig.2 Propeller and Spinner Installation

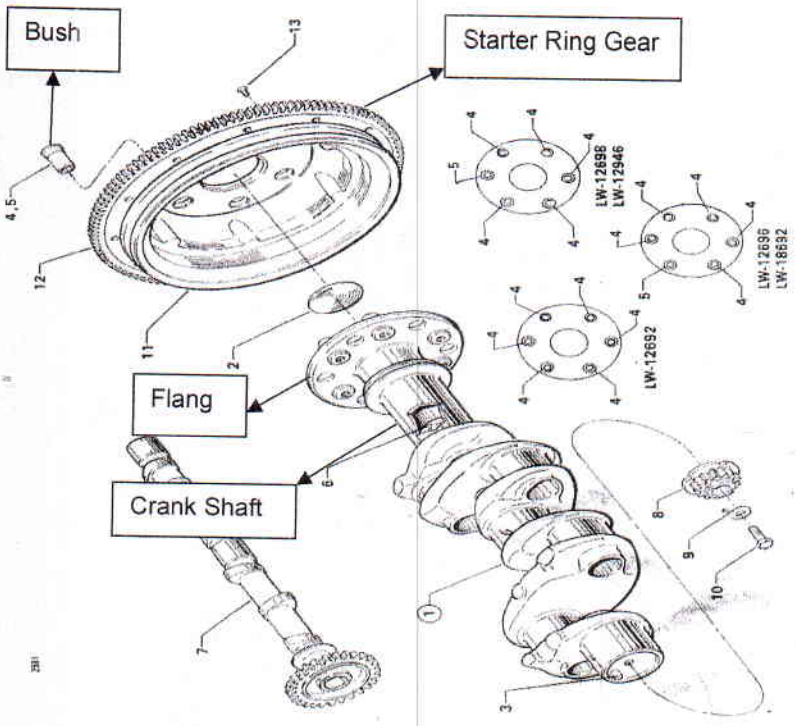


Figure 3. Crankshaft, Camshaft and Related Parts

Fig. 3 Crankshaft and Related Parts

Propeller Flange Bushing Location and Installation:

M/s Lycoming, the engine manufacturer has issued Service Instruction on propeller flange bushing location. The SI No. 1098G dated 30th April 2001 has been revised and issued as SI No. 1098H, dated 8th March 2012. The Service Instruction prescribes method to identify the correct part numbers, dimensions, and respective installation locations for propeller flange bushings on Lycoming engine models. A checklist is also included to record measurements. The SL says that **for correct propeller operation, bushings must be installed in the correct location on the propeller flange**. In the revision dated 8th March 2012, it includes a caution that

"IF THE CORRECT BUSHING IS NOT INSTALLED IN THE SPECIFIED LOCATION, THE PROPELLER WILL NOT BE INDEXED CORRECTLY AND EXCESSIVE PROPELLER BLADE STRESSES CAN OCCUR."

It prescribes use of bushing that will give a 0.0005 to 0.0020 in. tight fit between the bushing and its bore. The SL provides dimension 'A' and 'B' for each part no. of the bushing and also oversize for in service replacement.

For the type of engine and the flange thickness the prescribed Part No. of the bushing is 60814-S for five bushes and 73757-S for the reference bushing. The corresponding dimensions are as follows:

PART NO.	DIMENSION A (in.)	DIMENSION B (in.)
60814-S	0.6255-0.6260	0.95
73757-S	0.6725-0.6730	0.95

Table-1

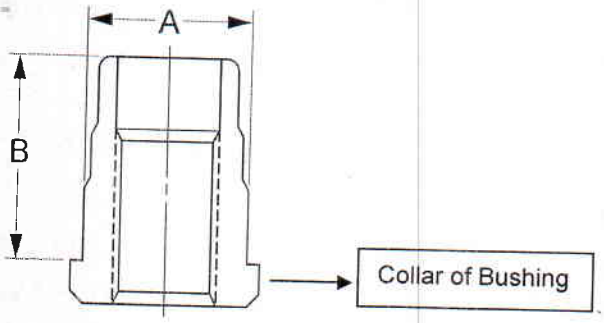


Fig. 4 Bushing

Description of the Magneto:

As per the Airplane Flight Manual "A sudden engine roughness or misfiring is usually evidence of magneto problems. Switching from BOTH to either L or R ignition switch position will identify which magneto is malfunctioning. Select different power setting and enrich the mixture to determine if continued operation on both magnetos is practicable. If not, switch to the good magneto and proceed to the nearest Airport for repair".

Wing Flap Setting:

Normal take-offs are accomplished with wing flaps 0-10 degrees. Using 10 degree wing flaps reduces the total distance over an obstacle by approximately 10%. Flap deflection greater than 10^0 is not approved for take-off. If 10 degree wing flaps are used for take-off, they should be left down until all obstacles are cleared and a safe flap retraction speed of 60 KIAS is reached. On short field 10 degree wing flaps and an obstacle clearance speed of 54 KIAS should be used. This speed provides the best overall climb speed to clear obstacles when taking into account turbulence often found near the ground level.

Soft or rough field take-off are performed with 10^0 wing flaps by lifting the Airplane off ground as soon as practical in a slightly tail low attitude. If no obstacles are ahead the Aircraft should be levelled off immediately.

Landing:

Normal landing approaches can be made with power-on or power-off at speeds of 60 to 70 KIAS with flap up, and 55 to 65 KIAS with flaps down. Surface winds and air turbulence are usually the primary factor in determining the most comfortable approach speeds.

Actual touchdown should be made with power-off and on the main wheels first. The nose wheel should be lowered smoothly to the runway as is diminished.

1.7 Meteorological Information:

There is no meteorological office located at Aligarh from where weather observations are taken and recorded. As per the people working at the Aligarh Airfield weather on the day of accident was cloudy and there was no rain at the time of accident.

1.8 Aids to Navigation:

Not Applicable

1.9 Communication:

Aircraft was in contact with ground R/T operator on VHF frequency. On R/T PII intimated that he would be proceeding to sector North at 2000 ft. R/T operator acknowledged the transmission and gave him takeoff clearance. Approximately 35s to 40s after takeoff, PII transmitted on R/T in panicked voice that he was returning back. After this there was no further transmission from the aircraft. The Walkie-Talkie person was not recording the conversation on his register.

1.10 Aerodrome Information:

Aligarh aerodrome is uncontrolled airfield. The airstrip is located 2.3nm North West of Aligarh VOR. It is 110°, 4.6 nm from Aligarh railway station. The aerodrome is used for flying by the three flying clubs. The runway orientation is 29/11. It is cleared for day VFR operation. It has been given the approval for the night flying training w.e.f. 29/11/2010. The runway is not equipped for the night flying. Goose neck lamps are used for night flying.

As per NOC issued by AAI, local flying is to be conducted within the local flying area (LFA) of 5nm radius centred at 27°51'43" N 078°08'53" E. Any flying beyond LFA is to carried out after filing flight plan with Delhi FIC and obtaining ATC clearance as applicable.

- **Runway Dimensions**
  - Length : 1220 meters (4000 feet)
  - Width : 23 meter (75 feet)

Threshold of R/W 11 is displaced by 40 m due to boundary wall in approach. Runway 29/11 is provided with the runway strip of 30m on either side of the runway as boundary wall is about 48 m from runway centreline.

- Elevation : 185meter
- There are no ATC facilities available at the airport.

1.11 Flight Recorders:

Aircraft is not equipped with recorders as per the existing regulations.

1.12 **Wreckage and Impact Information:**

The accident site was a paddy field with standing water. The final resting place of the main wreckage was at a distance of approximately 740 meters from the edge of runway 29 of Aligarh Airfield. The coordinates of the accident site are N $27^0$51'26.06", E $78^0$09'36.74"and elevation is 185m.

During site examination, propeller marks have not been recorded. As per the revised statement of chief engineer the propeller assembly was found lying before the final resting place of aircraft main wreckage and towards the left of direction of motion. However exact location of the separated propeller could not be ascertained. Comparing Fig. No. 5 and No.6 and taking into consideration the statement of the chief engineer, apparently the propeller had separated from the aircraft along with the mounting bolts and bushes before the final resting place of the wreckage. **After the accident the propeller was shifted and kept near the main wreckage (ref. fig. 6).** Then the aircraft impacted a bund of mud; almost 1m. high. During this process nose of the aircraft smashed into the cockpit and cockpit bottom area was completely damaged. The aircraft moved forward and finally came to rest at around 10 meters from the bund. Wreckage diagram is enclosed as Appendix 'A'.

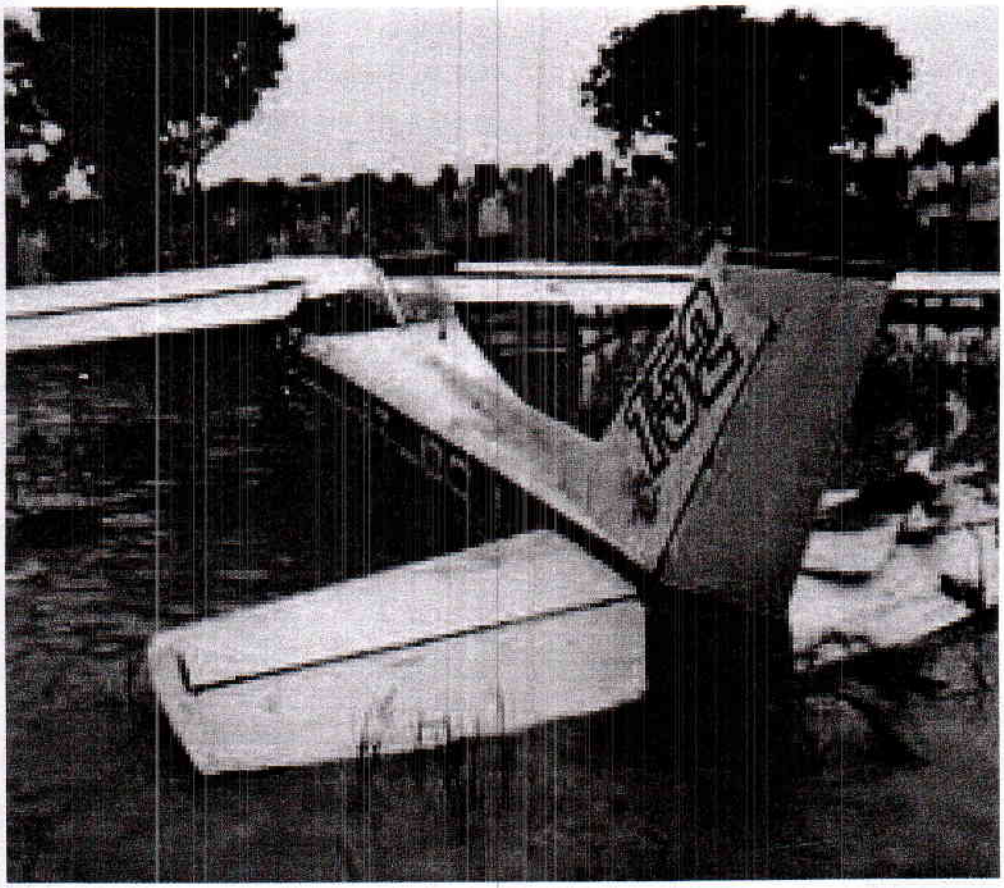


Fig. 5 Wreckage in final resting position (Photograph from media)

Fig. 6 Wreckage in its final resting place (Photograph by First IOA during site visit)

1.12.1 Observation of the Aircraft Cockpit and Fuselage:

Front pane/Plexi glass had shattered and roof of the cockpit was found damaged. Relatively more bending of the front windowpane frame was seen on the left side. Skin rupture was seen at the fuselage and tail boom intersection. Pilot side control column was found broken and bent downwards, Engine external parts were found damaged. Fuselage was found completely damaged. Damage was observed on instrument panel, control column Rudder pedals, Cabin doors and alternator disc.

Following positions of the instruments, switches & levers were recorded by Ist IOA:

- Ignition switch was found at 'L (left side)'.
- Beacon light switch, Landing light switch was found in 'ON' condition while Navigation light, dome light switches were found in 'OFF' condition.
- Mixture & throttle lever were found in full condition i.e. 'full open' position.
- Battery switch was found in 'ON' position.
- Flap switch position was found deflected approx. 2.5 degree.

1.12.2 Under Carriage

Due to impact left main landing gear wheel separated from the strut and was found lying below the left wing flap. The tubular spring steel strut of the left main gear had twisted up. The nose undercarriage broke and had folded back.

1.12.3 **Wings**

Right wing tip had hit he bund and was damaged along with the navigational light. No significant damage was observed on the left wing. The flaps were seen in the extended condition

1.12.4 **Control Surfaces**

Elevator, Aileron, Rudder surface- movement was checked manually and they were found free to move.

1.12.5 **Propeller Assembly**

The propeller assembly had come out from the fitting of the flange along with the mounting bolts and bushings. Collar has separated from each of the bush and they were not recovered. Propeller spinner was found deformed on one side due to impact with blunt object and there was penetration of the metal surface. Both the propeller blades had slight bent which can be associated to static impact. There was no damage to tip of the propeller. Apparently the propellers were not rotating at the time of impact.

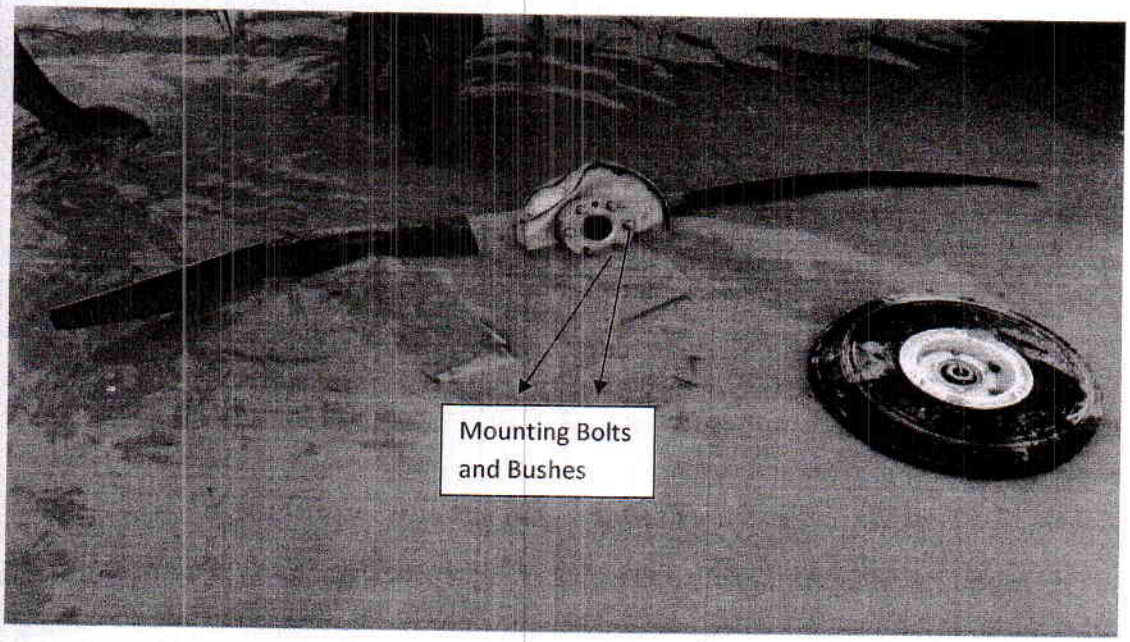


Fig. 7 **Propeller and hub Assembly**

1.12.6 **Inspection of Propeller Assembly:**

The disassembly of the propeller assembly was carried out at the facility of M/s Pioneer Flying Academy at Aligarh under the supervision of first IOA. However during the disassembly, the undoing torque was not measured/ recorded.

For detailed examination the propeller and hub assembly, mounting bolts and bushes were shifted to DGCA (H.Q.) New Delhi. The examination was carried out in the metallurgical lab of the DGCA and as well in the engine overhaul shop of Delhi Flying Club:

- On the spinner dome no sign of rotation was observed. Flat spots /penetration was observed on the opposite sides on the propeller hub due to impact with some hard object.

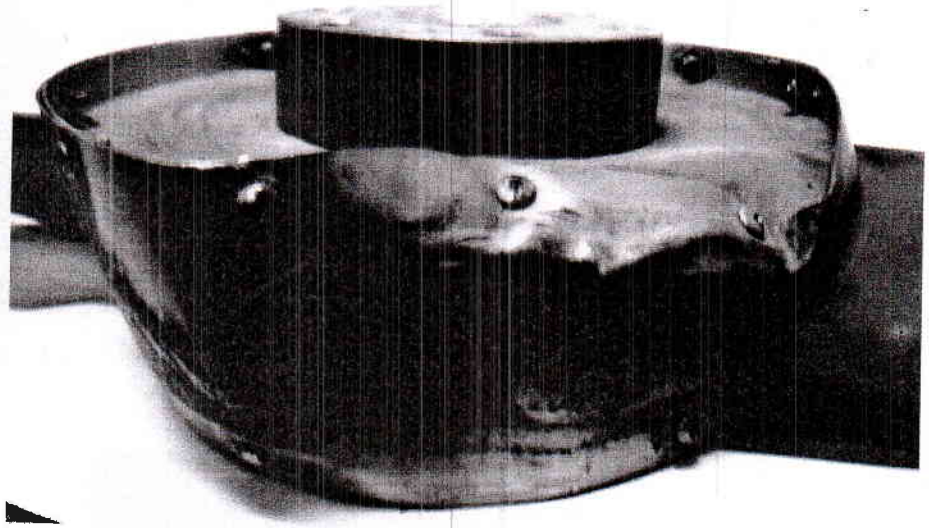


Fig. 8: **Damage on the propeller hub.**

- No twist was seen on the propeller blades. Both the propeller blades were bent backward. No nicks, gouges, and scratches were observed on the blade face/back, lead/trail edges and tips.
- Threads of all the propeller mounting bolts were intact and there was no appreciable bend.
- Circumferential rub marks/gouging of the metal were observed on the front face of the starter ring gear abutting with the aft face of the spacer indicating relative motion between the two. The holes of the ring gear for carrying the bushing were found to obliterated /oval in shape. In two of the holes groove marks/erosion of metal due the bolt was seen indicating the direction of the release of the bushing along with the bolts. On rear face of the ring gear abutting with the flange of the crankshaft, circumferential rub marks due to flange of the crank shaft was observed.

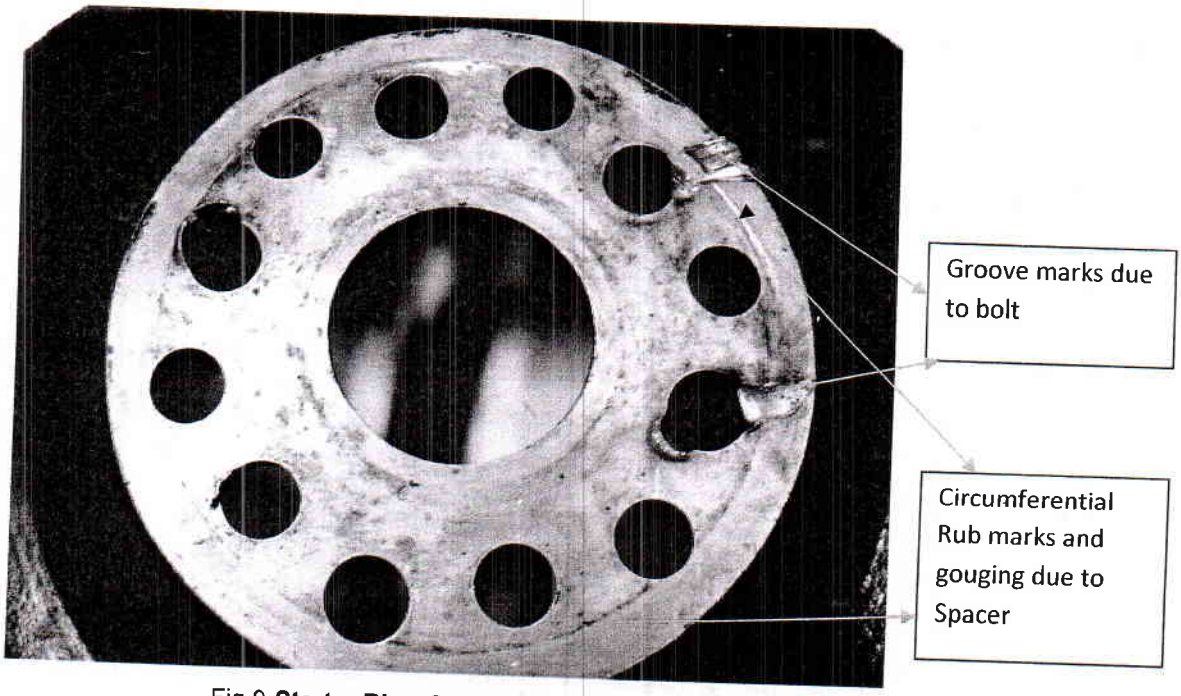


Fig.9 **Starter Ring Gear**

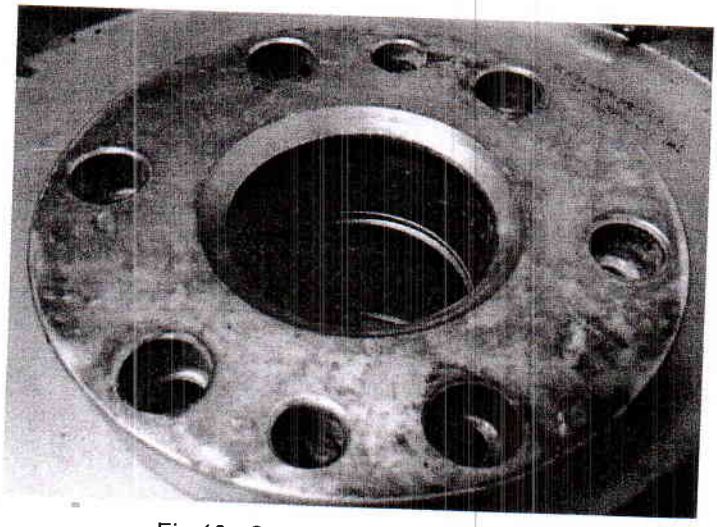


Fig.10 **Spacer**

- All the six crankshaft flange bushings had come out from the flange. **The collars of the bushes had separated and were not recovered.** The flange had bent and the bent was about 0.029 in.(run out). Ref fig 9. In one of the bore the edged was damaged in the backward direction indicating aft motion of the bushing.

- The diameter of bushing holes/bore on the crankshaft flange was measured and are as follows. (As the propeller assembly was disassembled without locating the reference position, the bore no. are not with reference to the location of the indexed part no. of the bush) :

1 (in)	2 (in)	3 (in)	4 (in)	5 (in)	6 (in) (flange bent)
0.624	0.624	0.626	0.625	0.629	0.624
0.623	0.623	0.625	0.624	0.628	0.638

Table-2

From above measurements it is seen that the variation in the flange bore diameter in case of five bores is 0.001 in. The SL does not provide any information for the variation of the bore dia. /tolerance.

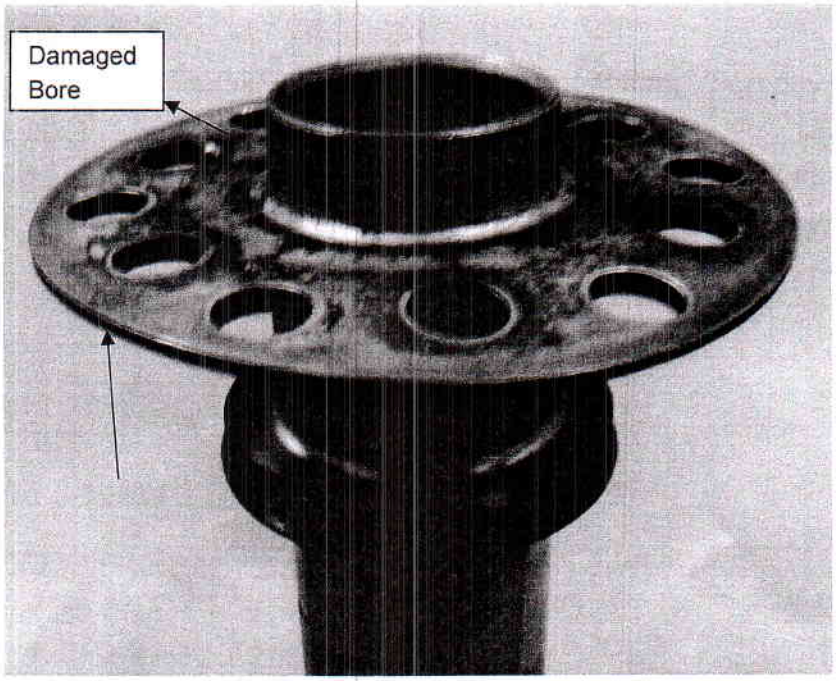


Fig. 9 **Crank Shaft Flange indicating bend**

The bushing dimensions "A" is as follows in table 3.

	No.1 (in)	No.2 (in.)	No.3 (in.)	No. 4(Index Pt. no.) (in.)	No. 5 (in.)	No. 6 (in.)
	0.627	0.626	0.629	0.674	0.625	0.627
	0.625	0.623	0.624	0.672		0.625
Variation in Dia	0.002	0.003	0.005	0.002	No variation	0.002

Table-3

From the above it is seen that there is variation in the outer diameter of the bush and the maximum variation seen is 0.005 in. The SL does not provide any information for the variation of the outer dia. /tolerance of individual bushing

Comparing table-1(page-13) and Table-3(page-21) it is seen that there is mismatch in the measured values of the diameter and the prescribed values. Further comparing table-2(page-21) and Table-3(Page-21), it is seen that the prescribed interference fit of 0.005 inch is not maintained.

1.13 Medical and Pathological Information:

Pilot & trainee both suffered serious injuries due to the collapsing aircraft structure. Both were taken to a Hospital in Aligarh.

a) **Pilot** was declared brought dead. As per post-mortem report the death was caused due to shock and haemorrhage as a result of lacerating wound and fracture of bones of forehead and face and left ankle joint.

b) **Trainee pilot** was admitted in the hospital for treatment. Two day after i.e. on 02-08-2011, while he was being shifted to a Hospital in New Delhi he also expired. His post-mortem report states that he died due to haemorrhage, shock and coma as a result of injuries on the forehead and face, fracture of bones of right leg and ankle.

1.14 Fire:

There was no fire.

1.15 Survival Aspect:

The accident occurred at 10.00 UTC. As per ground radio operator, PII was in conscious state after the accident. The team from the flying club reached the accident site immediately for rescue of crew. Pilot & trainee both suffered serious injuries during the accident and were rescued by the local farmers who were working in the paddy field at the time of accident. Subsequently both were taken to Varun Trauma & Burn Centre Pvt. Ltd. Quarsi Charkha, Ramghat Road Aligarh by flying club staff. They reached hospital at 10:30 UTC. Pilot was declared brought dead after reaching the hospital.

Trainee pilot was admitted in the hospital for treatment, later on after two days he was being shifted to a Hospital in New Delhi. On the way to Delhi he also expired on 02-08-2011.

1.1.6 Tests and Research:

1.16.1 Engine Examination

Engine of the Aircraft was strip examined at Delhi Flying Club in the presence of the first Inspector of Accidents and following observations were made:

1.16.1.1 **External Conditions**

- Propeller flange found bent.
- Alternator found damaged.
- Starter found damaged & jammed.
- Exhaust found badly damaged.
- Carburettor Air scoop found damaged and broken.
- Oil return line of cylinder No.2 found damaged.
- Induction pipes of cylinder No.2 & No.3 were found damaged.
- All engine baffles found damaged and broken.
- Carburettor including air filter found damaged.

1.16.1.2 **Strip Examination**

No damage was observed on any of the internal components of the engine. Crankshaft runout was within limits.

1.16.1.3 **Magnetos and Spark Plugs**

Both magnetos and all the spark plugs were bench tested and all were found satisfactory.

1.16.2 **Metallurgical Examination**

The failed bushes of the propeller bolts & engine flange fitting alternator drive disc were sent to the AED, O/o DGCA New Delhi. Following are the observation made in the laboratory examination report

- All the six bushes were found fractured at one end.
- Failure surface of one of the bushes was examined under SEM. SEM Factograph indicated dimpled fracture in shear mode. The presence of the shear dimple on the fracture surface indicates that all the bushes failed due to shear overload. The marks on the alternator drive disc holes were probably caused by bushes/bolts after failure.

1.16.3 **Fuel Examination**

Fuel sample (Gasoline 100 LL) was examined in the Fuel laboratory of the AED. As per the examination report the fuel sample passed the full specification test (specification No – DEF. STAN. 91-90 (Issue NO. 1)/IS 1604-1994)

1.16.4 **Engine Oil Examination**

The oil sample drawn from the aircraft was examined in the Fuel laboratory of the AED. The sample meets all the main characteristics tests of the specification (specification No - MIL-L-22851 D, Sample type – Engine Oil (SAE-60))

1.17 Organizational and Management Information

Pioneer Flying Academy Pvt. Ltd was initially granted approval on 21.08.2008. The approval was renewed periodically and was valid till 10/12/2011. The Flying club had the DGCA approval for flying training upto CPL level training. The organisation had purchased the aircraft involved in accident from M/s Plane Exchange Co., USA subject to the condition that:

- The engine overhauled with zero hours
- Airframe overhauled and undergone major inspection
- Flown less than 10,000 hours.

It has approval for maintenance of Cessna 172S aircraft fitted with Lycoming IO360L2A engine including its system installed thereon up to 200hrs /6 month inspection and Cessna 152 types of aircrafts for maintenance up to 200 hrs/1 year inspection.

Since 2008 there has been frequent change of aircraft maintenance engineers.

Scrutiny of maintenance and operations documents and records indicated poor upkeep. E.g. Authorisation Logbook is not serial numbered; life of engine was wrongly transferred from the logbook supplied by seller, POH has not been updated etc.

1.18 Additional Information

Nil

1.19 Useful and Effective Investigation Techniques

Nil

2. Analysis

2.1 Airworthiness of the Aircraft

2.1.1 Maintenance of the Aircraft

The Certificate of Airworthiness of the aircraft was current and valid. Periodicity of all scheduled maintenance task were maintained. As per the available records no snag was reported during last six months. Review of Tech log book also did not indicate repetitive snags.

On the day of accident the Certificate of Release to Service was issued by AME at 7:30 hours (UTC) for the day flying. However after release **two snags were encountered before takeoff.** First the headset was found defective and then there was some sluggishness on the control of the rudder. The Aircraft was attended by chief engineer and the defect of sluggishness was rectified by lubricating the rudder pedal at the apron itself. Both these snags are not mentioned in the Tech log/snag register. Apparently snags are not recorded.

Life of the engine has not been correctly transferred from the log books obtained from the previous owner. As per the export C of A issued by FAA the engine hours were 6888.6 Hrs. However as per the engine log book maintained by the operator, the engine hours at the time of accident were 4220:25 Hrs. Similarly the documentation of the propeller has not been correctly done. As per Export Certificate of Airworthiness issued by FAA the propeller model was 72CKS6-O-52. However as per the propeller logbook maintained by the operator the model was 72-CKS-O-54. As per the POH the model is McCauley Model No. 1A103/TCM6958. Also M/s Pioneer Flying Academy did not possess the **release note** of the bushes installed on the crankshaft flange.

The above indicates there is no proper review of the maintenance documents leading to incorrect information in the vital documents.

2.1.2 Serviceability of Engine and Accessories

30 to 35 seconds after takeoff, PII in the panicked voice intimated the ground radio officer that he was turning back. After accident throttle and mixture control were found in full open position. Examination of propeller assembly revealed

- No sign of rotation on the spinner dome.
- Flat spots /penetration on the opposite sides on the propeller hub due to impact with some hard object.
- No twist was seen on the propeller blades. Both the propeller blades were bent backward. In one of the blade the backward bend was quite significant.

- No nicks, gouges, and scratches were observed on the blade face/back, lead/trail edges and tips.

The above indicated that the propeller was not rotating at the time of impact.

To ascertain the serviceability of the engine, strip examination of the engine was carried out at Delhi Flying Club. During inspection no deficiency was observed.

Both the magneto and all the spark plugs were tested in and found satisfactory. Thus it can be safely concluded that there was no snag on the engine and its accessories and engine was producing power before the impact.

2.1.3 **Integrity of the Propeller Mounting**

Propeller assembly had separated from the engine along with its mounting bolts and the crankshaft flange bushings. Propeller had separated before the final resting place of the wreckage and was found lying left to the direction of the motion of the aircraft. **However later it was shifted to the main wreckage.**

Examination of the spinner, propeller blades did not indicate of rotation. However the engine was producing power. To ascertain the integrity of the propeller mounting detailed examination of the propeller assembly was carried out. The examination indicated as follows

- On the spinner dome no sign of rotation was observed. Flat spots /penetration was observed on the opposite sides on the propeller hub due to impact with some hard object.
- No twist was seen on the propeller blades. Both the propeller blades were bent backward. In one of the blade the backward bend was quite significant. No nicks, gouges, and scratches were observed on the blade face/back, lead/trail edges and tips.
- Circumferential rub marks/gouging of the metal were observed on the front face of the starter ring gear abutting with the aft face of the spacer indicating relative motion between the two. The holes of the ring gear for carrying the bushing were found to obliterated /oval in shape. In two of the holes groove marks/erosion of metal due the bolt was seen indicating the direction of the release of the bushing along with the bolts. On rear face of the ring gear abutting with the flange of the crankshaft, circumferential rub marks due to flange of the crank shaft was observed.
- All the six crankshaft flange bushings had come out from the flange. The collar of the bushes had separated and were not recovered. A significant bent was seen in the crankshaft flange.

The above damage to the propeller assembly indicated that there was relative motion between the ring gear and the propeller spacer which caused the

circumferential scoring/rub on the ring gear. This is possible only if the few of the fasteners are loose or given way. The damage on the ring gear also indicated the forcible release of the bushing/bolts.

To further examine the failure observed in the bushes i.e. separation of the collars, the failed bushings and the bolts were examined in the metallurgical examination lab. The examination revealed that all the crank shaft flange bushes had fractured from their collars due to shear overload. This implies that all the bushes failed under the pulling force of the propeller in the forward direction.

Further 200 hrs/1 year inspection carried out 03.11.2010 does not involve integrity check of the crank shaft flange bushings. Neither this integrity check appears to have been carried out during the bottom end overhaul of the engine on 15th Oct. 2008.

Comparing of flange bore dia. (Table-2/Page-21) and bushing outer dia. (Table-3/ page-21) indicates that the bushing outer diameter is not strictly meeting the requirements and it would not have given the interference fit of 0.005in. This may have caused stress on the collars leading to their separation. Damage seen on the ring gear bushing holes also indicates stress due to the bushing.

From above in service failure of the bushes cannot be ruled out. The failure may have been due to nonstandard interference fit between bushing and bore. This led to separation of the collar which would further cause loosening of the bush. A loosened bush would impact on the internal surface of the holes of the ring gear through which it passes. This matches with the damage observed on the holes of the ring gear. Once a bolt has become loose or is not carrying the load it will cause imbalance resulting in increased stress on the other bushes and the bolts. This would lead to sequential failure of all the bushes and the bolts.

Although the Daily inspection of the aircraft was carried out by the CE before the flight, Serviceability of the aircraft is a factor at the time of accident.

2.2 Crew Qualification and Proficiency

PII held valid license and were qualified on type. His ratings were current. The PII had a total flying experience of 2482.14 Hrs. His total instructional flying experience was 1853:15 hrs. PII had undergone I/R check on Cessna-152 aircraft on 25-07-2011, flew 01:00 hours and came back to Aligarh on 29-07-2011. However before this flight detail of the exercise to be carried out and location was not mentioned. As per the available records the trainee did not have any previous flying experience.

From above it can be concluded that the PII was proficient to carryout the training flight. However there does not appear to be proper planning of the training sortie.

2.3 Conduct of Flight and handling Emergency Situation

After obtaining clearance, the aircraft took-off from R/W 11 and was proceeding to sector North at 2000 feet. 35 to 40 sec. after take-off PII informed in panicked voice on R/T that they will be returning back. The R/T officer who was on duty came out from the R/T room and saw the aircraft taking right turn on the take-off path and losing height simultaneously. The aircraft came towards the ground and finally crashed in a paddy field.

During wreckage examination the flaps were found extended and flap lever was also found deflected to 2.5 °. Apparently the PII was in the process of retracting the flaps when the abnormal situation was encountered. He decided to return back instead of making forced landing in the field ahead. However before he could make the turn back the aircraft impacted the ground. Indicating that there was rapid loss of the altitude and PII could not handle the abnormal situation encountered.

As per Pilot's Operating Handbook the takeoff speed with flaps at 10° is 54 kts. Therefore he would have attained this speed during takeoff. The stall speed in turn with a bank up to 45° and with 10° flaps does not exceed the above mentioned take off speed. From the attitude of the aircraft at the time of impact and location of the final wreckage, the aircraft does not appear to be in high bank angle or turned much. Therefore probability of the aircraft having stalled during the turn without any other failure occurring and impacting the ground can be safely ruled out.

During the wreckage examination the magneto switch in the cockpit was found selected to L position. Examination of the spark plugs did not indicate any fouling/carbon or lead deposits. Before the flight magneto voltage drop check was carried out by the CE. Also during the bench test no deficiency was observed. Therefore malfunction of the magneto can be ruled out. Even if only one magneto is available as per POH, it allows sufficient engine power to fly to the nearest airport.

The propeller assembly of the aircraft had separated and found lying before the main wreckage and towards the left of the direction of the motion of the aircraft after the impact. Further the propeller examination did not show any sign of rotation and also it indicating circumferential rubbing between the spacer of the propeller assembly and the ring gear. Therefore from above it can be concluded

that the PII faced an abnormal situation due to loosening of the propeller mounting, a situation which PII may not have faced before and putting him in panic. Loss of thrust due to propeller malfunction may have caused loss of the forward velocity and therefore the lift. Thus causing aircraft to suddenly lose height and impact the ground.

2.4 Sequence of Events

On 29.07.2011 after daily inspection the Cessna 152 aircraft VT-PSJ was released for flying at 7:30 UTC. Pilot Instructor In charge (PII) started the aircraft at around 09:40 UTC for carrying out a training sortie with the trainee pilot. However he was not able to receive radio transmission made by ground R/T operator. The headset was changed and the aircraft was given clearance for taxy. The aircraft taxied straight ahead and then took a right turn. The aircraft was stopped and switched off on taxi holding point facing the runway. The PII called for the Chief Engineer (CE) on R/T to check the aircraft. PII reported some unease in the rudder pedal travel. After rectification, aircraft was released for the flight..PII and trainee pilot sat in the aircraft. After starting again, the aircraft was given clearance to taxi. Aircraft took off from R/W 11. PII intimated on R/T that he would be proceeding to sector North at 2000 ft and the same was acknowledged.

After approximately 35 to 40 seconds, when the aircraft was flying at an altitude of 200-300ft, it encountered abnormal situation. PII decided to return back and accordingly informed ground R/T operator, however in panicked voice. There after the aircraft was seen turning right and simultaneously losing height. The aircraft did not appear to have turned much before the impacting. On ground, aircraft impacted a bund of mud of approximately 1 meter height in a paddy field. The aircraft moved forward and came to rest at around 10 meters from the bund. The propeller assembly of the aircraft had separated from the engine along with the mounting bolts and bushes before the final resting place of the wreckage. The accident took place at approximately 10:00 UTC during the day time.

There was no fire. Besides propeller, nose wheel & left main wheel were found broken and separated from the fittings Due to collapsing structure both PII and trainee pilot suffered injuries. Both the occupants were retrieved from wreckage by the villagers working in nearby paddy fields. The PII & trainee were taken to a hospital in Aligarh for treatment. PII was declared brought dead and trainee was hospitalized for treatment. Two days after on 02/08/2011, the trainee pilot also died while being transferred to a hospital in Delhi.

3. Conclusion

3.1 Findings

3.1.1 PII was appropriately licensed to operate the flight.

3.1.2 After 150 hours/09 month scheduled inspection aircraft was not flown for more than one month.

3.1.3 On the day of accident the Certificate of Release to Service was issued by AME at 7:30 hours (UTC) for the day flying. However after release **two snags were encountered before takeoff**. Both the snags are not mentioned in the Tech log/snag register. Apparently snags are not recorded.

3.1.4 The aircraft suffered extensive damage to its structure & engine due to impact.

3.1.5 There was no snag on the engine and its accessories and engine was producing power before the impact.

3.1.6 Propeller assembly had separated before the final resting place of the wreckage and was found lying left to the direction of the motion of the aircraft. **However later it was shifted to the main wreckage. Thus the wreckage was disturbed.**

3.1.7 The propeller examination did not show any sign of rotation at the time of impact.

3.1.8 There was relative motion between the ring gear and the propeller spacer which caused the circumferential scoring/rub on the ring gear. This is possible only if the few of the fasteners are loose or given way. The damage on the ring gear also indicated the forcible release of the bushing/bolts.

3.1.9 All the six crankshaft flange bushings had come out from the flange. The collar of the bushes had separated and was not recovered. A significant bent was seen in the crankshaft flange.

3.1.10 All the failed bushes were found fractured from their collars due to shear overload i.e under the pulling force of the propeller in the forward direction.

3.1.11 The bushing outer diameter is not strictly meeting the requirements and it would not have given the interference fit of 0.005in. This may have caused stress on the collars leading to their separation. Damage seen on the ring gear bushing holes also indicates stress due to the bushing.

3.1.12 Although the Daily inspection of the aircraft was carried out by the CE before the flight, Serviceability of the aircraft is a factor at the time of accident.

3.1.13 After encountering the abnormal situation, the PII panicked and decided to return back to the airfield. However there was rapid loss of height and aircraft impacted the ground. Loss of thrust due propeller malfunction may have caused loss of the forward velocity and therefore the lift. Thus causing aircraft to suddenly lose height and impact the ground.

3.1.14 There does not appear to be proper planning of the training sortie.

3.1.15 M/s Pioneer Flying Academy did not possess the **release note** of the bushes installed on the crankshaft flange.

3.1.16 There is no proper scrutiny of the maintenance and operations documents, thus leading to wrong information being available in the vital documents.

3.2 Probable Cause of the Accident

Accident occurred due to impact with the ground following a sudden loss of height as crew encountered an abnormal situation. The encountered abnormal situation may be due to loosening of the propeller mounting.

4. Safety Recommendations

4.1 Procedure for the integrity check of propeller mounting bushing may be introduced at some stage in the maintenance programme.

4.2 One time check may be carried out on all the Cessna 152 aircrafts to verify the compliance of Service Instruction No. 1098H (reissue dated March 8, 2012) regarding the Part No. of the flange bushes installed on such aircraft.

4.3 Thorough inspection of the maintenance documents and release note be carried out before initial issue of C of A.

4.4 Action as deemed fit may be taken against the organisation for not ensuring security of the wreckage.

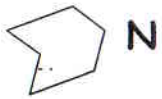
4.5 Importance of proper planning of the training sortie and briefing of the trainee pilot should be reiterated.

(Maneesh Kumar)
Inspector of Accidents
VT-PSJ

Dated: 15/02/2013

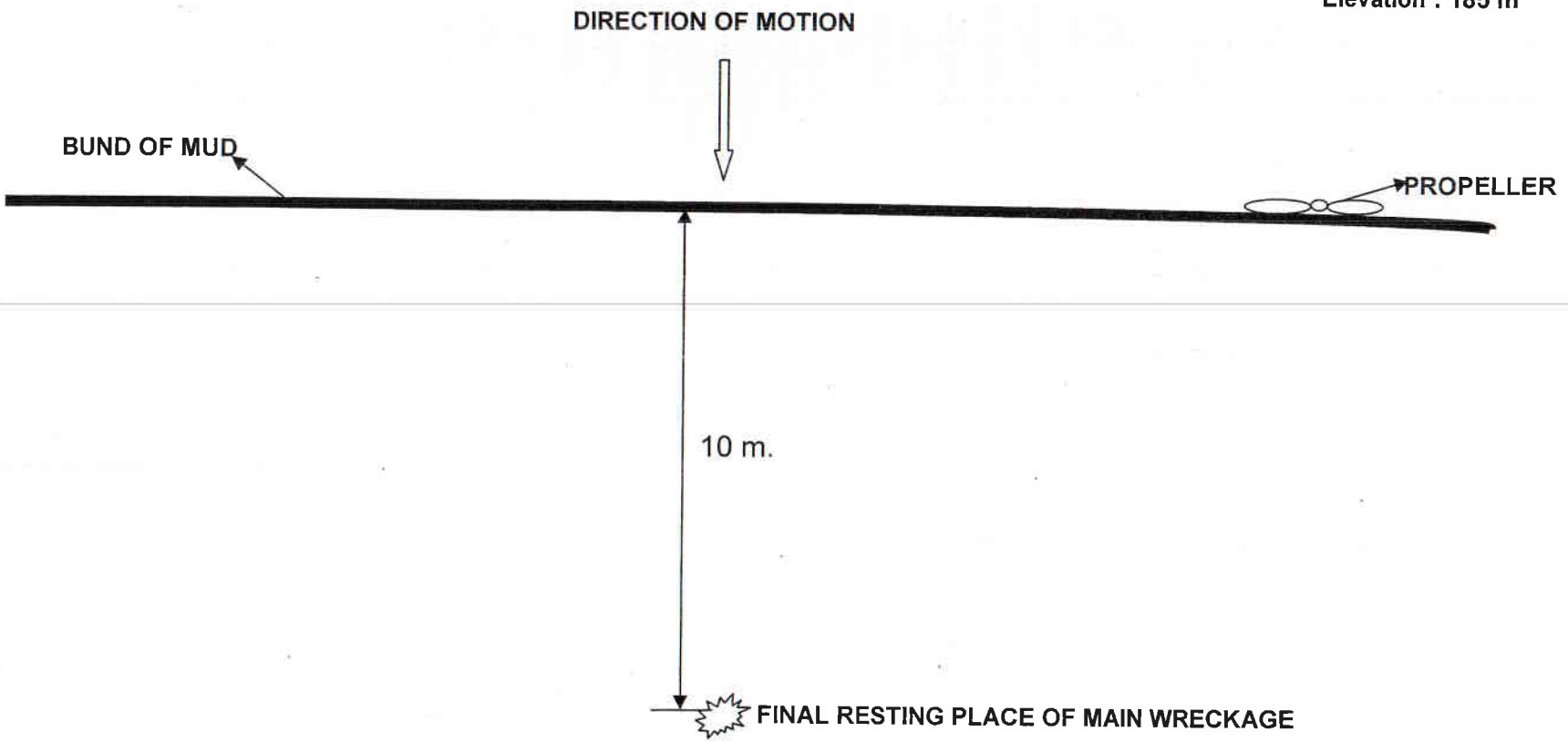
APPENDIX "A"

WRECKAGE DISTRIBUTION DIAGRAM



Coordinates:

Latitude: N 27°51'26.06
Longitude: E 78°09'36.74"
Elevation : 185 m



Appendix B

GLOSSARY OF ABBREVIATIONS USED IN THIS REPORT

AAI	:	Airports Authority of India
AED	:	Aeronautical Engineering Directorate
AME	:	Aircraft Maintenance Engineer
CE	:	Chief Engineer
C of A	:	Certificate of Airworthiness
CPL	:	Commercial Pilot License
DGCA	:	Directorate General of Civil Aviation
FAA	:	Federal Aviation Administration (USA)
FRTOL	:	Flight Radio Telephone Operator's Licence
ft.	;	Feet
in.	:	Inch
IOA	:	Inspector of accidents
IR	:	Instrument Rating
KIAS	:	Indicated Air Speed in Knots
Kts	:	Knots
nm	:	Nautical Miles
m	:	Meter
POH	:	Pilot's Operating Handbook
PII	:	Pilot Instructor In charge
R/T	:	Radio Telephony
SL	:	Service Letter
SPL	:	Student Pilot License
SEM	:	Electron Microscope
R/W	:	Runway
RPM	:	Revolutions per minute
TSO	:	Time Since Overhaul
TSN	:	Time Since New
UTC	:	Coordinated Universal Time
VFR	:	Visual Flight Rules