FINAL INVESTIGATION REPORT

SERIOUS INCIDENT OF M/S. KK AVIATION CESSNA – 172 AIRCRAFT REG. NO. AP-BJG AT JINNAH INTERNATIONAL AIRPORT (JIAP) ON 06TH JUNE, 2017

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Synopsis

The serious incident was reported to Safety Investigation Board (SIB) of Pakistan by the operator through Mandatory Occurrence Report **(Appendix 'A')** and was investigated as per Memorandum vide Letter No. HQCAA/1901/395/SIB dated 15th June, 2017 authorizing SIB, Pakistan to investigate the serious incident **(Appendix 'B')**. The investigation was conducted by SIB, Pakistan (the state of registry / operator / occurrence) to recommend suitable measures to prevent a recurrence.

1. FACTUAL INFORMATION

1.1. **History of the Flight**. On 06th June, 2017 a serious incident occurred to M/s KK Aviation's Cessna-172 aircraft, Registration No AP-BJG (Training Flight) at JIAP, Karachi. During landing roll shortly after the landing, heavy vibrations were felt followed by immediate stopping of the aircraft on the runway on its own. The engine was shut down immediately on the runway after seeking clearance from ATC to check for the abnormality. On visual inspection, it was revealed that the nose wheel had detached from the fork assembly of nose leg.

1.2. **Injuries to Persons**. No injuries were reported to any person.

1.3. **Damage to Aircraft**. Fork Assembly of Nose Landing Gear was found bent.

1.4. **Other Damage.** None.

1.5. **Personnel Information.** Not applicable.

1.6. **Aircraft Information**. As per operator, the mishap aircraft was being maintained in accordance with the regulations of Pakistan Civil Aviation Authority. Pertinent aircraft and major parts maintenance and life information is as follows:

1.6.1. **Aircraft**

Aircraft Make & Model	Cessna-172
Registration Marking	AP-BJG
Manufacturer Serial No	17276537
Year of Manufacture	1986
C of A (S No. , expiry date)	748/1, 14-04-2018
Maint review prior to 06-06-2017 (date, hrs, expiry date)	01-06-17, Hrs 21547:00 EXP: 30-06-17
Daily inspection prior to 06-06-2017occurrence (date, location)	06-06-17, Karachi
Total Aircraft Hours as on 06-06-2017 (prior to occurrence)	21581:20
Last Check-C (type, date, hrs, agency performed & location) prior to occurrence	CHK III Hrs 200:00 Insp 18-05-17 KK Engineering Karachi Hanger.
Last Check-A (type, date, hrs, agency performed & location) prior to Occurrence	CHECK I Hrs 50:00 Insp 25-05-17, KK Engineering Karachi Hanger.

Nose Leg / Nose Wheel

S No	Date	Details of Sch / Un-sch maintenance	Hrs Flown till 06-06-2017
1	04-05-17	Check II Hrs 100:00 Sch Maintenance	228
2	11-05-17	Check I Hrs 50:00 Sch Maintenance	180
3	18-05-17	Check III Hrs 200:00 Sch Maintenance	129
4	25-05-17	Check I Hrs 50:00 Sch Maintenance	82
5	01-06-17	Check II Hrs 100:00 Sch Maintenance	34

1.6.2. As per OEM's MM, the nose wheel is required to be removed on every 500 hrs scheduled maintenance. Lastly, this 500 hrs check was accomplished on 20 August, 2016 at 21250 aircraft hours. Since then the aircraft has flown 331 hrs **(Appendix 'C')**.

1.7. **Meteorological Information**. Not applicable.

1.8. **Aids to Navigation**. Not applicable.

1.9. **Communications**. Not applicable.

1.10. **Flight Recorders**. Not applicable.

1.11. **Wreckage and Runway Marks Information**. Nil.

1.12. **Medical and Pathological Information**. No injury reported to any person.

1.13. **Fire**. Not applicable.

1.14. **Survival Aspects**. Not applicable.

1.15. **Organizational and Management Information**. Not applicable.

1.16. **Additional Information**. Not applicable.

1.17. **Useful and Effective Investigation Techniques.** Standard investigation techniques were used.

2. ANALYSIS

2.1. **Technical Analysis**

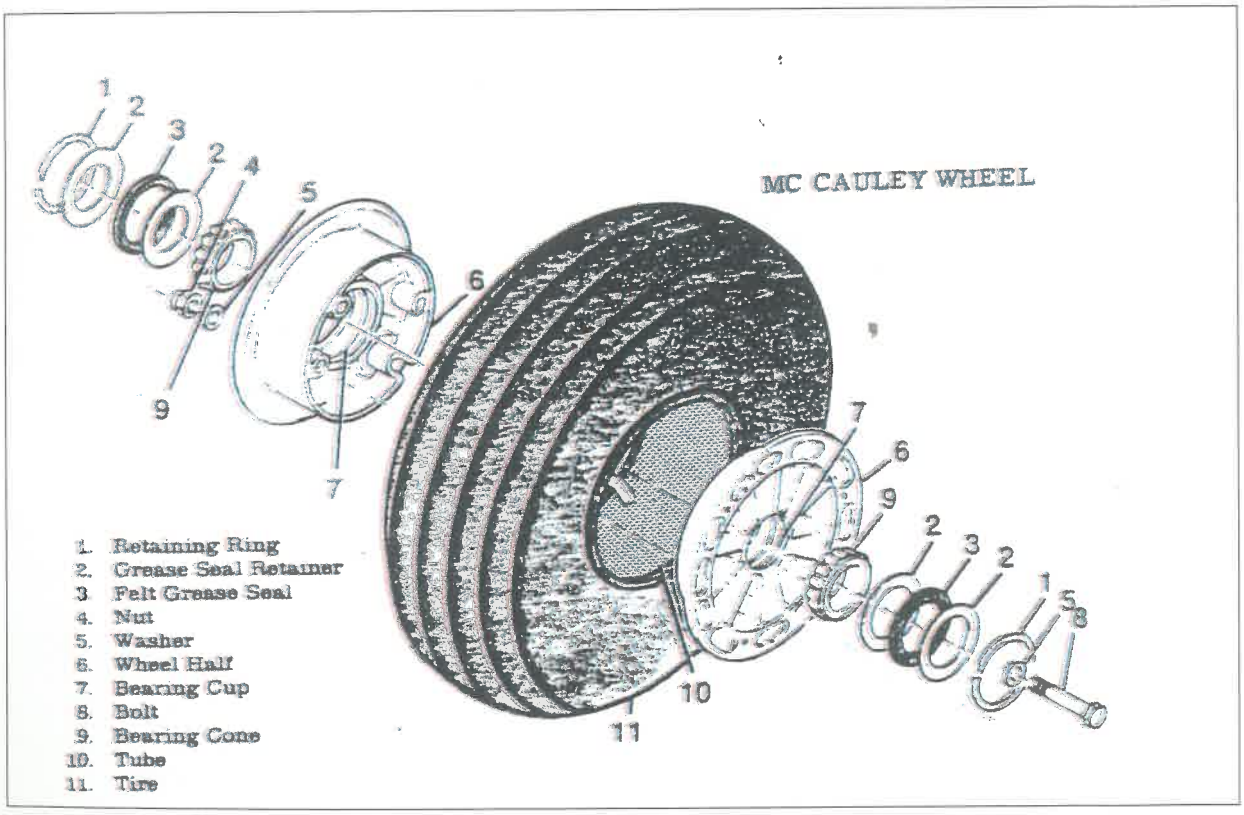
2.1.1. The following picture shows the location of failed part and other related components of Nose wheel assembly.

Nose Wheel Assembly C-172

2.1.2. On post incident, nose wheel was found completely detached from the fork of nose landing gear and the aircraft was towed back to the premises of KK Aviation using a wheel disable dolly.

Nose Wheel completely Detached Away from the Fork

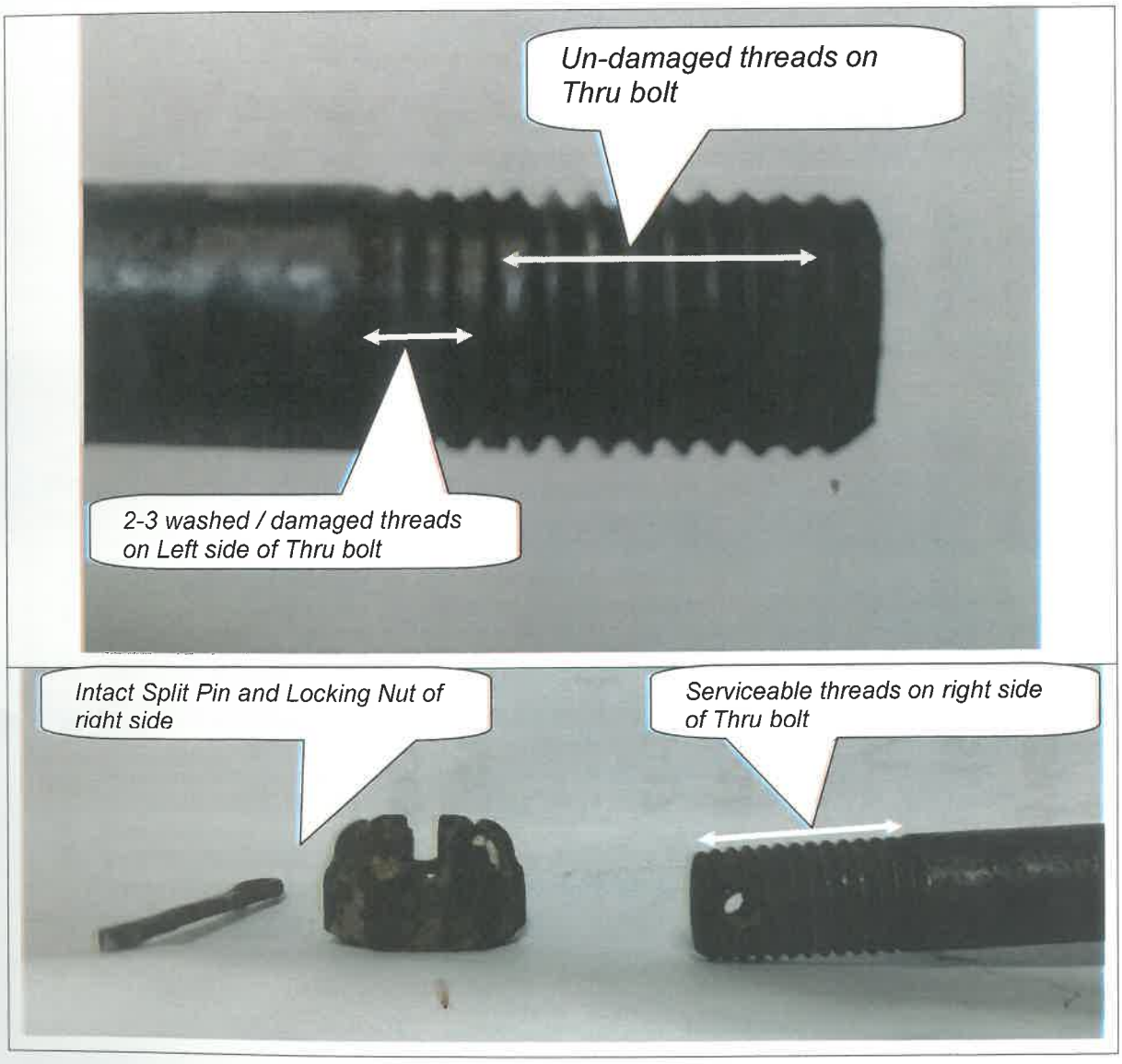
2.2. **Mechanism of Nose Wheel on Cessna-172.** The aircraft is equipped with 03 fixed legs including nose leg. The nose wheel is installed between a Fork with the help of different parts as shown in the picture below :



2.2.1. There are 02 identical sets of parts (One set contains S Nos 1-9 except S No 8 Thru Bolt which is used in Qty-01) to assemble the nose wheel onto the fork.

2.2.2. During post incident inspection, it was found that Thru Bolt (S No 8 as mentioned in the picture given above) was deficient of its one out of the two sets as shown in the picture below :

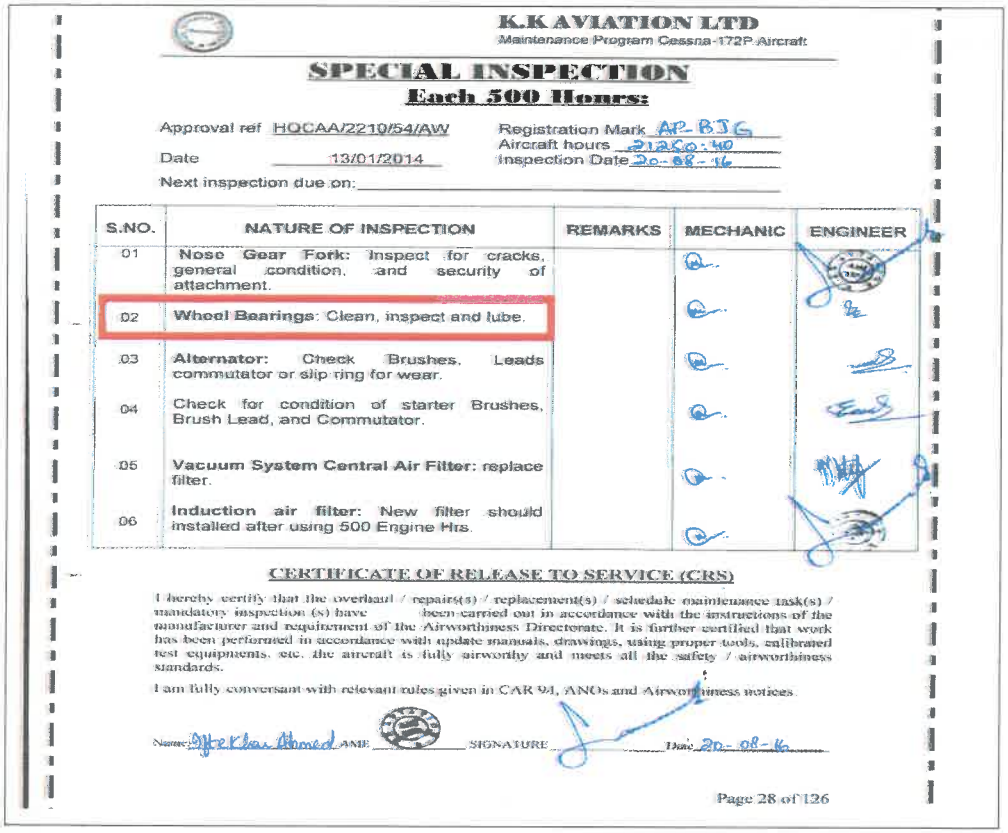
2.2.3. It was evident that the securing nut (S No 4) was missing along with its split pin besides other parts. Further visual and close examination of the threads show that 2-3 male threads on this thru bolt have been washed away at the point where the nut reaches once it is fully tightened whereas the remaining threads are in serviceable condition :



2.2.4. The damaged 2-3 male threads at the point where the nut reaches once it is fully tightened, indicate that the nut has initially slipped over these damaged male threads causing the split pin to slice away. The split pin is kept in place to avoid inadvertent rotation of the lock nut on thru bolt. Once the split goes away, the lock nut shall not retain its locked position and shall be rotated with the rotation of the nose wheel causing it to free the thru bolt.

2.2.5. The other intact end of the Thru Bolt was disassembled at the workshop as shown in the picture given above. The male threads on this end of the Thru Bolt are in serviceable condition.

2.2.6. The nose wheel is removed after every 500 hrs for servicing of the bearings. Last 500 hrs inspection was carried out on 20 August, 2016 and the aircraft had flown 331 hrs since then till day of the occurrence.



K.K AVIATION LTD
Maintenance Program Cessna-172P Aircraft

SPECIAL INSPECTION
Each 500 Hours:

Approval ref HQCAA/2210/54/AW
Registration Mark AP-BJG
Date 13/01/2014
Aircraft hours 2120:40
Inspection Date 20-08-16
Next inspection due on:

S.NO.	NATURE OF INSPECTION	REMARKS	MECHANIC	ENGINEER
01	Nose Gear Fork: Inspect for cracks, general condition, and security of attachment.			
02	Wheel Bearings: Clean, inspect and lube.			
03	Alternator: Check Brushes, Leads commutator or slip ring for wear.			
04	Check for condition of starter Brushes, Brush Lead, and Commutator.			
05	Vacuum System Central Air Filter: replace filter.			
06	Induction air filter: New filter should installed after using 500 Engine Hrs.			

CERTIFICATE OF RELEASE TO SERVICE (CRS)

I hereby certify that the overhaul / repairs(s) / replacement(s) / schedule maintenance task(s) / mandatory inspection (s) have been carried out in accordance with the instructions of the manufacturer and requirement of the Airworthiness Directorate. It is further certified that work has been performed in accordance with update manuals, drawings, using proper tools, calibrated test equipments, etc. the aircraft is fully airworthy and meets all the safety / airworthiness standards.

I am fully conversant with relevant rules given in CAR 94, ANOs and Airworthiness notices.

Name: Iftekhar Ahmed AME SIGNATURE Date 20-08-16

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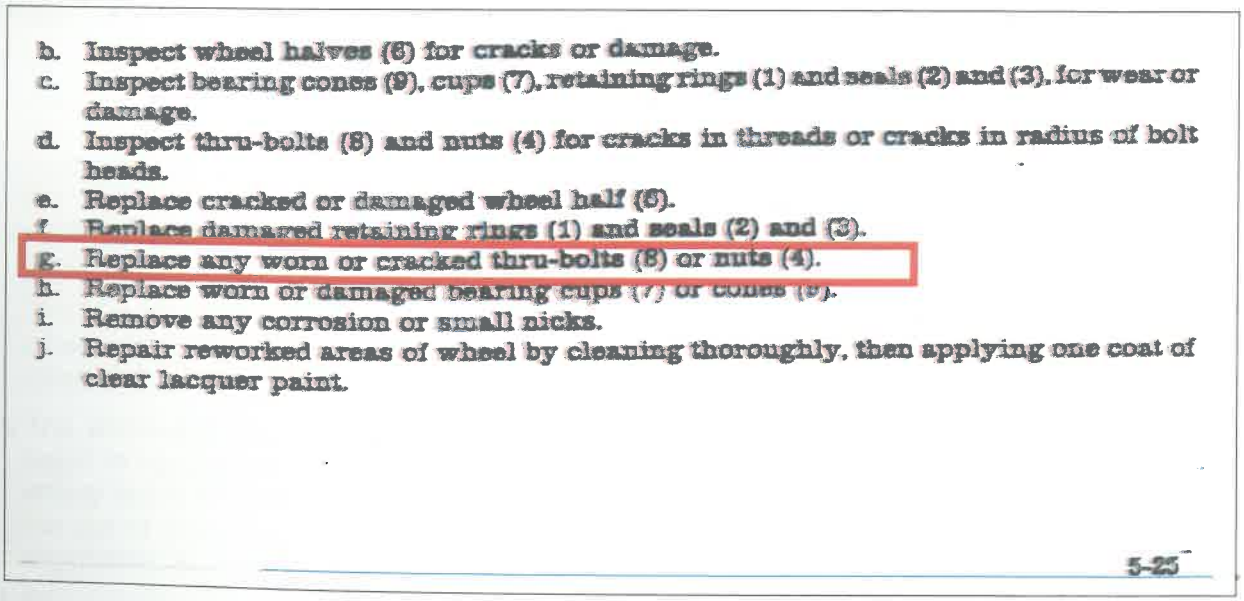
2.2.7. As per servicing manual of this aircraft Page 5-25 (given below), different parts like Retaining Rings, Seals, Nut etc are to be inspected and replaced if found damaged or cracked or worn out.



b. Inspect wheel halves (6) for cracks or damage.
c. Inspect bearing cones (9), cups (7), retaining rings (1) and seals (2) and (3), for wear or damage.
d. Inspect thru-bolts (8) and nuts (4) for cracks in threads or cracks in radius of bolt heads.
e. Replace cracked or damaged wheel half (6).
f. Replace damaged retaining rings (1) and seals (2) and (3).
g. Replace any worn or cracked thru-bolts (8) or nuts (4).
h. Replace worn or damaged bearing cups (7) or cones (9).
i. Remove any corrosion or small nicks.
j. Repair reworked areas of wheel by cleaning thoroughly, then applying one coat of clear lacquer paint.

5-25

2.2.8. On the contrary, the worn out condition of male threads on Thru Bolt (as shown above) clearly suggest that Thru Bolt was to be replaced during previous inspection(s), however, same was not done at KK Aviation. Consequently, the Thru Bolt couldn't retain its Split Pin

and Lock not leading to inadvertent detachment of the nose wheel from its fork assembly just after landing.

2.2.9. The stock level of different parts pertaining nose wheel Assembly / disassembly was checked as on the day of occurrence (06-06-2017) was as tabulated below :

S No.	Noun / Nomenclature	Pt No / NSN	Qty Used for one Nose Wheel inspection	Qty available in Stock at KK Aviation
1	**Nut**	**AN310-5**	**02**	**00**
2	Split pin	MS24665-134	02	37
3	**Thru Bolt**	**0742410-27**	**01**	**00**
4	**Snap Ring**	**A1636-23**	**02**	**00**
5	**Grease Seal Ring**	**A30048 ALTERNATE NUMBER 153-00800**	**04**	**00**
6	Bearing Cone	**A30078-1**	**02**	**04**
7	**Outer Wheel Half**	**C30598**	**01**	**00**
8	**Inner Wheel half**	**C30598**	**01**	**00**
9	Bearing Cup	**A30078-2**	**02**	**06**

2.2.10. The stock level essentially required to accomplish just one part of a scheduled inspection (Inspection & Greasing of Nose Wheel Bearing) found quite in-sufficient, this speaks of Organizational weakness that they are continuing routine operations without having adequate stock of the essentially required spares.

2.2.11. In order to evaluate the working practice at KK Aviation Engineering, the maintenance team was asked to remove and then install the nose wheel of another C-172 as per their procedure. In this regard, it was observed that the Engg Team was in a habit of opening the nose wheel by removing Nut from one side (mostly from left side) of the Thru Bolt. Although, the maintenance manual doesn't impose any restriction, however, this observation further substantiate the above finding where 2-3 male threads on one side of the thru bolt have been found damaged and the threads on other side are in serviceable condition.

2.2.12. There is no specific torque defined in the maintenance manual while assembling the nose wheel. It says, *"Tighten Axel Stud until a slight bearing drag is obvious when wheel is rotated. Back the nut off to the nearest castellation position and insert cotter pins."*

2.2.13. The working practice of removing nut from just one end as there being no restriction shall result in routine wear / tear to the male threads of Thru bolt on one end only at the point where nut is to face the maximum torque i.e. fully tightened position. In order to maximize the life of Thru Bolt and minimize its wear / tear, the nuts of Thru Bolt can be removed alternately as a better engineering practice.

2.2.14. The mechanism of Nose wheel is such that the entire load of aircraft nose transfers to the tyre thru its Axel Tube without passing through the Thru Bolt (there is no load on Thru bolt from the nose of the aircraft). As a result of such a design, the stress of hard landing would damage the Axel Tube at first, however, the Axel Tube has been found free of any such

damage as shown in the picture below. Owing to this mechanism, the possibility of detachment of the nose wheel as a result of hard landing has been ruled out.

2.2.15. In order to investigate that in a case where an operator is continuing its flying operations without requisite spares, is there any further filter to highlight such a weakness of the operator. In this regard, SOP of PCAA (Version 2.0, Issue Date 15 March, 2011) regarding Renewal of Certificate of Airworthiness was consulted **(Appendix 'D')**. This investigation has revealed the following facts :

2.2.15.1. It is a comprehensive SOP to certify fitness of an aircraft as well as its organization for the next one year.

2.2.15.2. The SOP even caters for availability of required tools to carry out the maintenance and routine flying operations (Refer Checklist given in its Appendix 'A' for certifying aircraft with less than 5700 Kg weight).

2.2.15.3. The SOP however does not clearly mentions about availability of essentially required spares to accomplish the scheduled and un-scheduled maintenance / inspections likely to go thru during the next one year.

3. CONCLUSIONS

3.1 Findings

3.1.1 The aircraft was serviced properly prior to the mishap flight and there was no carried forward defect which could contribute to the incident.

3.1.2 On post incident, nose wheel was found completely detached from the fork of nose landing gear and the aircraft was towed back to the premises of KK Aviation using a wheel disable dolly.

3.1.3 The nose wheel is installed between a Fork with the help of different parts.

3.1.4 There are 02 identical sets of parts to assemble the nose wheel onto the fork.

3.1.5 The securing nut of Thru Bolt was missing along with its split pin besides other parts.

3.1.6 Visual and close examination of the threads show that 2-3 male threads on this Thru bolt had been washed away at the point where the nut reaches once it is fully tightened whereas the remaining threads were in serviceable condition.

3.1.7 The other intact end of the Thru Bolt was disassembled at the workshop which showed that the male threads on this end of the Thru Bolt are in serviceable condition.

3.1.8 The nose wheel is removed after every 500 hrs for servicing of the bearings. Last 500 hrs inspection was carried out on 20 August, 2016 and the aircraft had flown 331 hrs since then till day of the occurrence.

3.1.9 As per servicing manual of this aircraft, different parts like Retaining Rings, Seals, Nut etc are to be inspected and replaced if found damaged or cracked or worn out during this 500 hrs inspection.

3.1.10 On the contrary, the worn out condition of male threads on Thru Bolt clearly suggest that Thru Bolt should have been be replaced during previous inspection(s), however, same was not done at KK Aviation.

3.1.11 The Thru Bolt being in such a bad condition couldn't retain its Split Pin and Lock not, leading to inadvertent detachment of the nose wheel from its fork assembly just after landing.

3.1.12 The stock level essentially required to accomplish just one part of a scheduled inspection (Inspection & Greasing of Nose Wheel Bearing) found quite in-sufficient at KK Aviations as checked on the date of occurrence. This speaks of Organizational weakness that they are continuing routine operations without having adequate stock of the essentially required spares.

3.1.13 There is no specific torque defined in the maintenance manual while assembling the nose wheel.

3.1.14 The working practice of removing nut from just one end as there being no restriction resulted in routine wear / tear to the male threads of Thru bolt on one end only at the point where nut is to face the maximum torque i.e. fully tightened position.

3.1.15 The mechanism of Nose wheel is such that the entire load of aircraft nose transfers to the tyre without passing through the Thru Bolt (there is no load on Thru bolt from the nose of the aircraft). As a result of such a design, the stress of hard landing would not directly be applied to the Thru Bolt. Owing to this mechanism, the possibility of detachment of the nose wheel as a result of hard landing is being ruled out.

3.1.16 SOP of PCAA regarding Renewal of Certificate of Airworthiness revealed that it is a comprehensive SOP to certify fitness of an aircraft as well as its organization for the next one year.

3.1.17 The SOP also caters for availability of required tools to carry out the maintenance and routine flying operations, however, it does not mention / direct about checking the availability of essentially required spares to accomplish the scheduled and un-scheduled maintenance / inspections on the aircraft being certified during the next one year.

3.2 Cause of Occurrence

3.2.1 The worn out condition of male threads on Thru Bolt lead to in-advertant slicing of the Split Pin leading to un-tightening of Lock Nut. Consequently, the Thru Bolt came out at its own from its Fork Assembly which resulted in detachment of the nose wheel during landing roll.

4. SAFETY RECOMMENDATIONS

4.1. KK Aviation is required to ensure strict adherence to the steps mentioned in the maintenance manual provided by the OEM with a special emphasis on conditional change items.

4.2. KK Aviation is required to maintain an adequate stock level of all spares essentially required to carry out scheduled and un-scheduled maintenance of the aircraft.

4.3. KK Aviation is required to carry out one time inspection of Thru Bolts of all aircraft of same type held at their end to identify and replace any unserviceable one.

4.4. Directorate of Air Worthiness, PCAA is recommended to revisit their checklist for C of A to ensure that an operator has adequate stock of spares to accomplish schedule and un-schedule servicing of an aircraft at least for next one year.

4.5. Directorate of Air Worthiness is requested to issue necessary instructions to all operators for in-time replacement of conditional change items.

(MIAN TAHIR AFTAB)
Wing Commander
Additional Director
Tech investigation SIB

Dated: 08 August, 2017

(MUHAMMAD MUNIR BUTT)
Air Commodore
President SIB
Investigation Incharge

Dated: 09 August, 2017