Transporta nelaimes gadījumu un incidentu izmeklēšanas birojs

Transport Accident and Incident Investigation Bureau of the Republic of Latvia

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FINAL REPORT No. 4-02/2-18(2-19)

ON AIRCRAFT SERIOUS INCIDENT INVOLVING AIRCRAFT PIPER PA 28-140, REGISTRATION No. YL-JKV AT AERODROME SPILVE ON 5 JULY 2018

The Aircraft Accident and Incident Investigation Bureau of the Republic of Latvia is a governmental, independent of all aviation authorities and, in general, of any other party or entity the interests or missions of which could conflict with the task entrusted to the safety investigation authority or influence its objectivity, organization established by law to investigate and determine the cause or probable cause of accidents and serious incidents that occurred in the civil aviation, as well if necessary for enhancing flight safety incidents. The sole objective of the safety investigation in accordance with Annex 13 to the Convention on International Civil Aviation, the Regulation (EU) No.996/2010 of the European Parliament and of the Council of 20 October 2010 on the investigation and prevention of accidents and incidents in Civil Aviation as well as Cabinet Regulation No.423 of May 31, 2011 "Procedures of Civil Aviation Accident and Incident investigation" is the prevention of future accidents and incidents. The Report shall contain, where appropriate, safety recommendations. **Safety investigation is separate from any judicial or administrative proceedings and Investigation Report is not deal with purpose to apportion blame or liability but only for purpose of the safety enhancement.** The Report shall protect the anonymity of any individual involved in the accident or serious incident.

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FINAL REPORT No. 4-02/2-18(2-19)

On aircraft serious incident involving aircraft Piper PA 28-140, registration No. YL-JKV at aerodrome Spilve on 5 July 2018

Body

Synopsis

ABBREVIATIONS USED IN THE FINAL REPORT

ATIS	- Automatic terminal information service
CAA	- Civil Aviation Agency
GPS	- Global Positioning System
ACFT	- Aircraft
VFR	- Visual flight rules
UTC	- Coordinated Universal Time
TAIIB	- Transport Accident and Incident Investigation Bureau
JAA	- Join Aviation Authorities
JAR	- Joint Aviation Rules
AGL	- Above ground level

FCL - Flight crew licensing
Kts - knot (nautical mile per hour)
RPM - revolutions per minute

GENERAL INFORMATION REGARDING THE AVIATION ACCIDENT

All information in the Final Report is indicated according to the local time (UTC + 3).

On 5 July 2018 an aircraft serious incident involving aircraft Piper PA-28-140, registration No. YL-JKV, occurred at aerodrome Spilve. During the flight damage to the right-hand landing gear strut of the aircraft was noticed.

During emergency landing at aerodrome Ādaži aircraft sustained insignificant damages, the pilot and the passenger did not sustain injuries in the aircraft serious incident.

Figure 1. Aircraft Piper PA-28-140

INVESTIGATION

Employees of the Transport Accident and Incident Investigation Bureau (TAIIB) received information by phone regarding the aircraft serious incident involving aircraft PA-28-140, registration No. YL-JKV, which had taken place in the area of aerodrome Ādaži.

Aviation accident investigators of the TAIIB went to the site of the accident in order to perform ascertaining of the circumstances of and questioning of witnesses to the aircraft serious incident.

The aircraft had been moved from the site of the incident and placed in the hangar of aerodrome Ādaži for its storage and further investigation of the incident.

1. FACTUAL INFORMATION

1.1. History of the flight

On 5 July 2018, upon preparing aircraft Piper PA-28-140, registration No. YL-JKV, for flight, the pilot and the passenger took off from aerodrome Spilve.

Around 6.30 p.m. after another T**ouch-and-go landing** (**TGL**) exercise above the runway of aerodrome Spilve when the aircraft had climbed up reaching the height of 1000 feet, the pilot noticed a vibration on the right-hand side of the aircraft. The passenger who was seated on the right-hand side performed visual scan and detected damage to the right-hand landing gear. In order to mitigate the consequences of emergency landing of the aircraft, the pilot made the decision to perform emergency landing in an aerodrome with a soft surface covering and afterwards directed the aircraft to aerodrome Ādaži.

After successful emergency landing at aerodrome Ādaži, visual inspection of the right-hand landing gear strut and wheel was performed detecting that the wheel was holding on to the landing gear strut only by the brake system hose.

Figure 2. Right-hand landing gear strut

1.2. Injuries to Persons

None.

1.3. Damage to Aircraft

The aircraft sustained the following damages to the structure:

- protective shield of the right-hand landing gear has been bent forward;

Figure 3. Protective shield of the right-hand landing gear strut cylinder

- torque link lugs (ear) at oleo cylinder of right-hand landing gear have been broken off;

Figure 4. Breaking points of the torque link lugs (ear) at oleo cylinder of right-side landing gear

Figure 5. Broken-off torque link lugs (ear)

The aircraft sustained insignificant damages to the structure in the aircraft serious incident and can be restored for further operation.

1.4. Other Damage

The surrounding environment has not sustained any damages.

1.5. Personnel Information

Aircraft pilot:	- Citizen of the Republic of Latvia, 41;
Pilot licence:	- Flight crew licence LVA.FCL.000711P.8112210388, issued on 22 January 2014 by the CAA of Latvia, ratings valid: SEP (land) until 31 May 2019, FI(A) until 31 January 2020;
Medical certificate:	issued on 1 August 2017 by the CAA of Latvia, valid until 1 August 2019;
Total flight experience:	- 1264.2 hours;
Last qualification check of the aircraft pilot:	- on 20 April 2017;

Flight hours on the day before the aircraft serious incident: - None;

Flight hours on the day of the aircraft serious incident: - 1 hour 15 min.

1.6. Aircraft Information

Aircraft Piper PA-28 is light aircraft built by Piper Aircraft Inc., designed for flight training and personal use. The aircraft is all-metal, single-engined monoplane with low-mounted wings and non-retractable tricycle landing gear (Figure 6). The aircraft has a single door on the pilot side, which is entered by stepping on the wing.

Figure 6. Aircraft Piper PA-28

1.6.1. Aircraft Fuselage

Manufacturer:	- Piper Aircraft Inc., USA;
Aircraft model:	- PA-28-140;
Serial number:	- 28-7225264;
Year of manufacture:	- 1972;
Registration No.:	- YL-JKV;
Registration licence:	- JKV20140708REG, issued by the CAA of Latvia on 8 July 2014;
Airworthiness Review Certificate:	- ARC/PA28-140/YL-JKV/004, issued by *PSAC Rīgas Aeroklubs* Ltd., valid until 30 April 2019;
Engine TSN:	- 7323.5 hours;
Flight hours since the last 50-hour technical maintenance:	- approximately 29 hours;
Registered owner:	- private individual;
Air operator:	- private individual.

1.6.2. Engine

Manufacturer of engine:	- Lycoming Engines, Inc., USA;

Model of engine (piston): - Lycoming O-320 D3G;
Serial number of engine: - L-13198-39A;
Engine TSN: - approximately 7022.35 hours.

1.6.3. Propeller

Manufacturer of propeller: - Sensenich;
Serial number of propeller: - 74DM6-0-58.

1.6.5. Aircraft Weight

Empty weight of the aircraft: - 544 kg;
Maximum takeoff weight of the aircraft: - 975 kg;
Actual takeoff weight of the aircraft: - was approximately 740 kg.

100 hour recurrent inspection was performed on 27 April 2018.
50 hour recurrent inspection for engine was performed on 4 June 2018.

1.7. Meteorological Information

Was not requested. Information regarding meteorological conditions on 5 July 2018 is not related to the aircraft serious incident.

1.8. Aids to Navigation

None.

1.9. Communications

There is no information regarding the use of communications.

1.10. Aerodrome Information

Aerodrome Ādaži (ICAO code – EVAD):
- designed for visual flights;
- aerodrome runway markings 15/33;
- elevation – 8 feet;
- runway surface: ASPHALT+GRASS.

Location:
- Rīga District, Ādaži Municipality, "Eimurlauki";
- direction and distance from Ādaži village: 2.2 NM NW

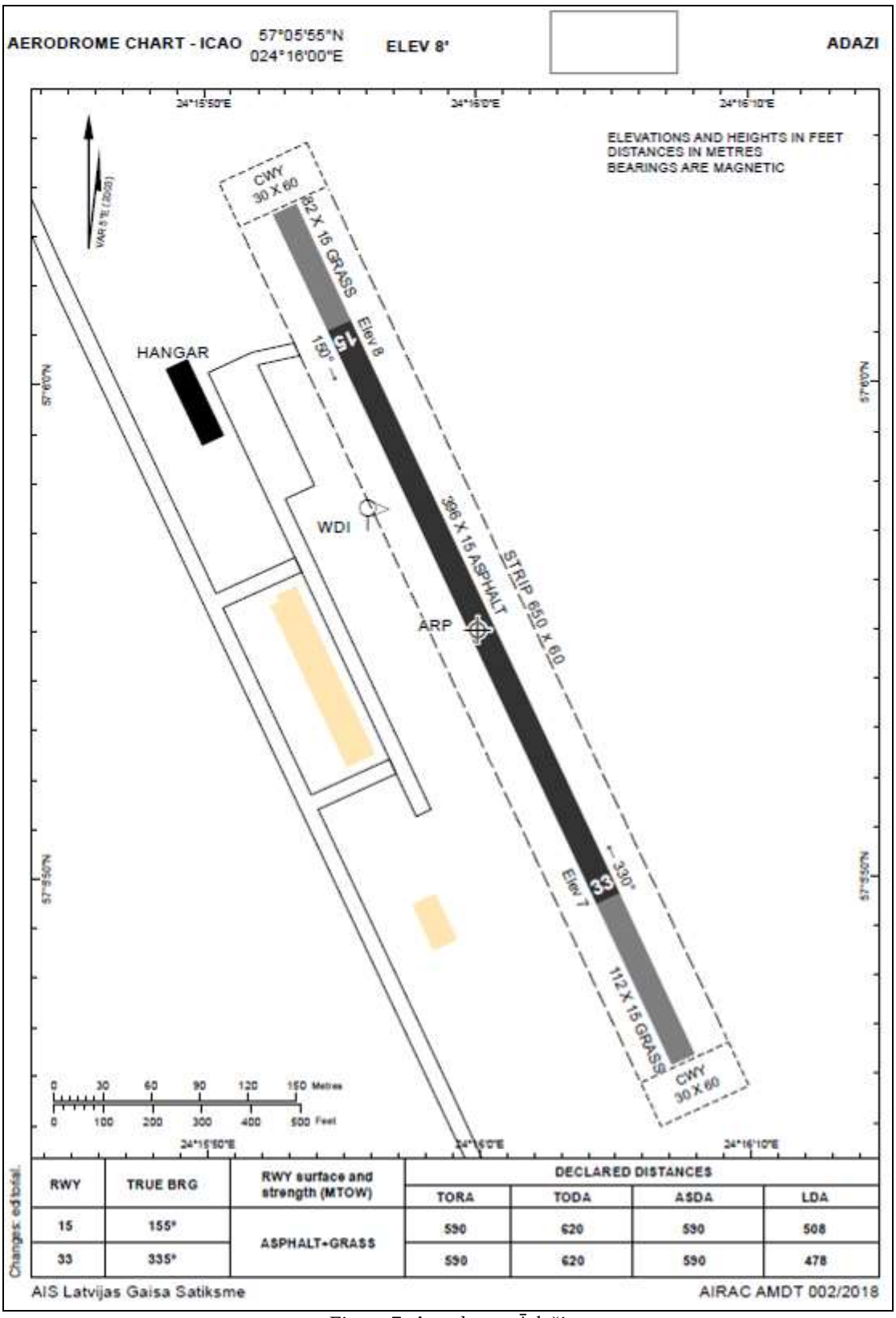

Figure 7. Aerodrome Ādaži

Aerodrome Ādaži is designed for general aviation flights, it is not equipped with instrumental landing systems and is freely accessible.

1.11. Flight Recorders

None.

1.12. Wreckage and Impact Information

None.

1.13. Medical Information

None.

1.14. Fire

Had not been caused.

1.15. Survival Aspect

The aircraft pilot and the passenger had not been injured upon landing.

1.16. Tests and Research

After dismantling of the right-hand landing gear strut of the aircraft its visual inspection was performed, checking in detail fractures in the right-hand landing gear strut lugs at strut housing; fatigue fractures of lugs were detected.

In order to determine the reasons for disintegration of the material of oleo cylinder torque link lugs of the right-hand landing gear of the aircraft and to establish the potential damages before or during flight, the damaged oleo cylinder was sent for the performance of metallurgical expert-examination to the Department of Material Processing Technology of the Faculty of Mechanical Engineering, Transport and Aeronautics of Riga Technical University (RTU).

1.16.1. Metallurgical Investigation of Damages to the Right-hand Landing Gear of the Aircraft

The Department of Material Processing Technology of Riga Technical University was assigned to perform technical analysis of landing gear oleo strut fracture, to determine the nature of the fracture and the circumstances of its occurrence.

Figure 8. Fracture overview magnified twice

It was detected during technical analysis that the fracture of the landing gear strut had occurred upon the aircraft performing multiple takeoffs and landings during the period of use. The material of strut torque link lugs (ear) was obtained, using casting method in a metallic mould, therefore, fine-grained layer had formed in the upper layer. Analysis of the fracture surface shows that the fracture bears the nature of low-cycle fatigue having occurred due to varying loads during the use. It is visible in Figure 8 that the fracture had started in the lower part of torque link lugs. The surface of the fracture has adjusted and become lighter there. After a low-cycle (change in load) number the cross-section of the surface decreased and the load caused the ultimate fracture throughout the cross-section. Upon placing the broken-off torque link lug to the site of fracture, a crack was detected (Figure 9).

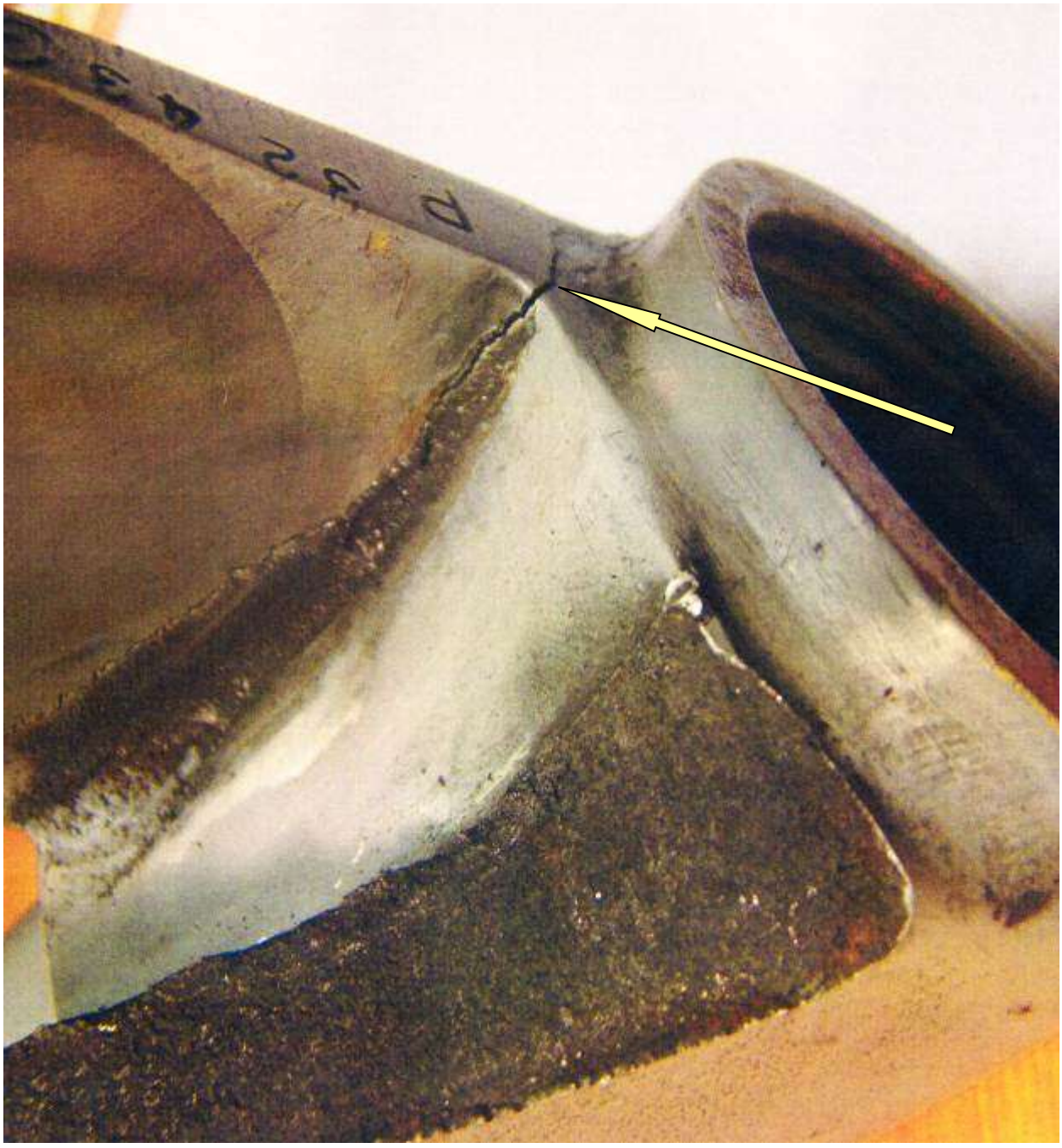

Figure 9.

The crack occurred during the use and was not noticed during recurrent inspections. The surface of the fracture is grainy in nature, the fine-grained layer of casting is visible on the external edge, forming a shiny surface of fracture which could be the initial cause for the fatigue fracture (Figure 10).

Figure 10.

After one side of the lug broke off the load on the other side increased, and due to the increased load it also broke off. The surface of the fracture (Figure 11) has the structure of grainy casting without the signs of plastic deformation. When the wheel of the landing gear hits the ground, compressive stress occurs in the upper part of the torque link lug, changing the nature of the fracture surface.

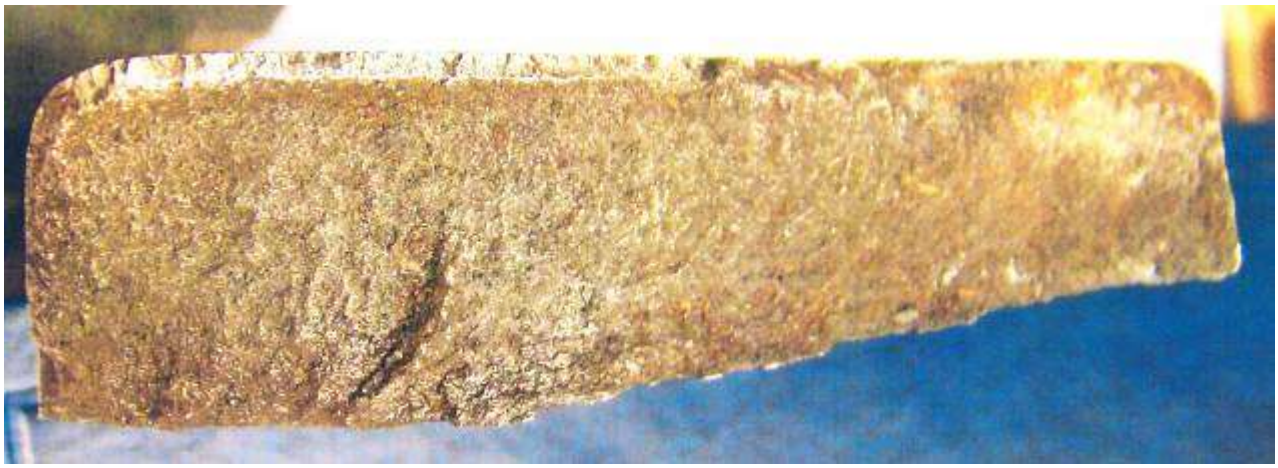

Figure 11.

1.17. Organisational and Management Information

1.17.1. Continuing Airworthiness of the Aircraft

On 13 June 2014 the aircraft owner entered into a contract with the airworthiness maintenance management organisation *Rīgas Aeroklubs* Ltd. regarding maintaining airworthiness of aircraft PA-28-140, registration No. YL-JKV, and development of the maintenance programme.

On 6 July 2014 the Civil Aviation Agency issued the first-time Airworthiness Certificate No. JKV2014071625.

On 1 May 2018 *Rīgas Aeroklubs* Ltd. issued the Airworthiness Review Certificate ARC/PA28-140/YL-JKV/004 for the aircraft PA-28-140, registration No. YL-JKV, valid until 30 April 2019.

1.17.2. Aircraft Maintenance

On 31 August 2017 100 hour recurrent inspection of the aircraft was performed. According to the maintenance programme inspection of the "cast" main landing gear strut housing was performed in accordance with the Service Bulletin SB1131 of the aircraft manufacturer on the basis of the EASA Airworthiness Directive AD 2005-0035.

On 27 April 2018 repeated inspection of the "cast" main landing gear strut housing was performed according to the Bulletin SB1131 of the manufacturer.

Maintenance was performed according to the maintenance programme of aircraft Piper PA-28-140, registration No. YL-JKV. Inspections of the "cast" main landing gear strut housing were performed visually, as well as applying the paint method, and inspection was performed by an authorised technician with EASA Part66 license No. LT-TI-640. After completing work the technical specialist issued the authorised Certificate of Release to Service.

1.17.3. Aircraft Maintenance Programme

On 23 October 2017 in accordance with Articles M.A.302(g) and M.A.302(h) of Regulation (EU) No 1321/2014 the aircraft owner confirmed reviewing of the maintenance programme in Paragraph 7 of the programme.

On 10 April 2018 the aircraft owner performed an audit of the aircraft maintenance programme in order to include new or changed instructions for maintenance therein which had been issued by holders of the aircraft type certificate, as well as any other organisation. Changes in pages 3 and 4 of the maintenance programme were made which do not apply to maintenance of the aircraft landing gear.

The airworthiness maintenance management organisation *PSAC Rīgas Aeroklubs* Ltd. has not performed the audit of the maintenance programme for aircraft PA-28-140, registration No. YL-JKV.

1.18. Other Relevant Information

1.18.1. Maintenance of the Aircraft According to the Service Bulletin SB 1131

According to the manufacturer's manual and the maintenance programme, maintenance and inspection of the main landing gear structure was performed after every 100 flight hours for aircraft PA-28-140, registration No. YL-JKV, in accordance with the Service Bulletin No. 1131 of the manufacturer of the aircraft Piper-28 on the basis of EASA Airworthiness Directive No 2005-0035 of 22 December 2005. The fact that work was performed was confirmed by the signature of the authorised technician and the stamp "**LT-TI-640**".

In accordance with the Service Bulletin No. 1131 torque link lugs on the "cast" main landing gear strut cylinders should be especially inspected for cracks and damages, using a 10X power magnifying glass and inspecting the top and bottom connections (Figure 12).

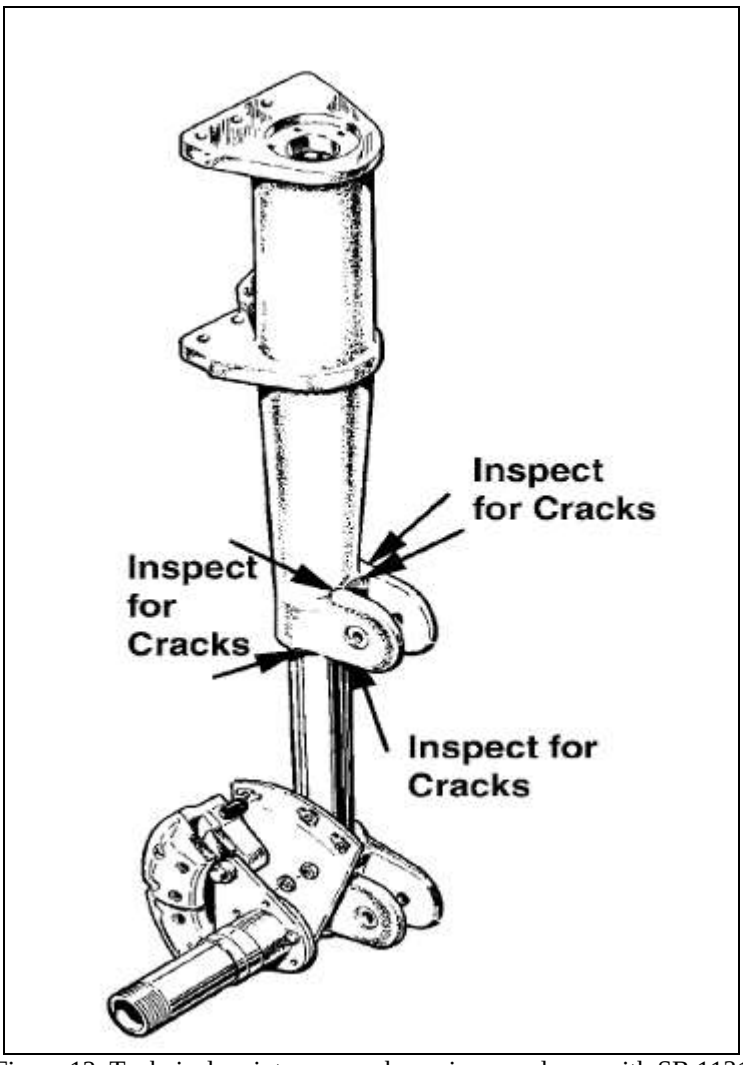

Figure 12. Technical maintenance scheme in accordance with SB 1131

If fractures or cracks were not found after visual inspection, the paint method must be used. If cracks are detected, the landing gear strut cylinder must be changed.

1.18.2. Aircraft Maintenance in Accordance with the Service Bulletin

The Service Bulletin SB 1131**A** developed by the aircraft manufacturer Piper Aircraft Inc. supersedes the Bulletin SB 1131 in its entirety and must be introduced by operators from 18 January 2016. Paragraphs 1 and 6 of the Service Bulletin SB 1131A describe and illustrate the additional activities for maintenance (Figure 13) which allow the performance of inspection procedures of torque link lugs (ear) on the main landing gear strut cylinders of the aircraft Piper-28 from the inside after dismantling of the swivel joint of the strut.

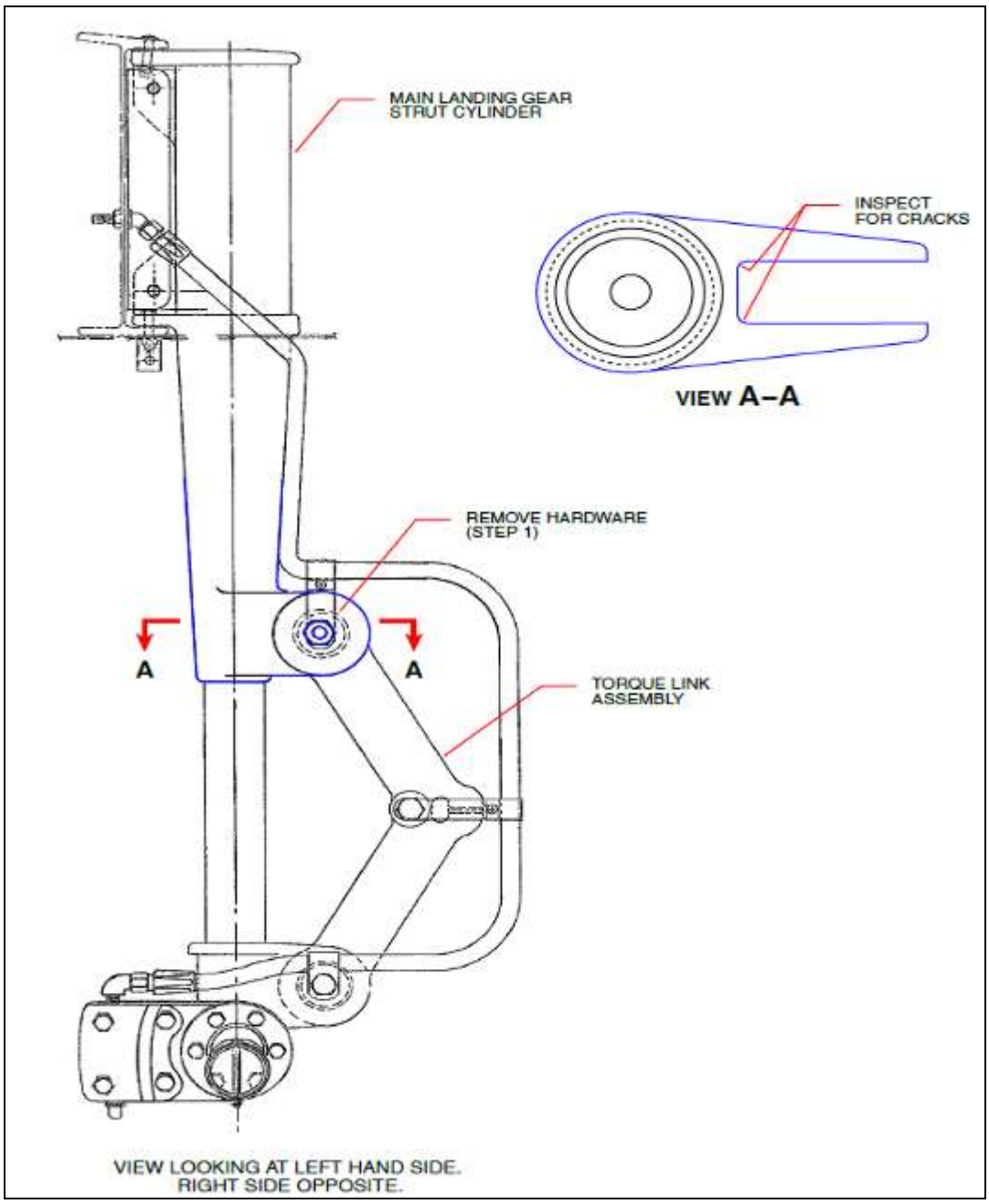

Figure 13. Illustration of the Service Bulletin SB 1131A

1.19. New Inspection Methodology

None.

2. ANALYSIS

2.1. Aircraft Flight

According to the pilot of the aircraft Piper PA-28-140, registration No. YL-JKV, upon preparing the aircraft for the flight according to the control sheet, no technical defects were detected and no remarks were made on the technical condition of the aircraft.

During the flight visual damage to the aircraft was detected as a result of vibration of the aircraft fuselage. The aircraft pilot took a correct decision to perform emergency landing in an aerodrome with a soft covering.

2.2. Fracture Analysis of the Aircraft Landing Gear Strut

According to the results of the technical analysis of the fracture of the aircraft landing gear strut it may be concluded that the cycle when cracks in the right-hand landing gear oleo strut housing of the aircraft formed occurred during the use, and metal fatigue at the fracture site of torque link lugs (ear) formed gradually.

Fatigue fracture in the "cast" landing gear strut cylinder started in the lower part of torque link lugs (ear) of the swivel joint where a micro-crack had emerged during the use, later transforming into a fatigue fracture. According to the detected signs of formation of a crack it is possible that the site of occurrence of the fracture was inside the torque link lugs (ear) (Figure 14).

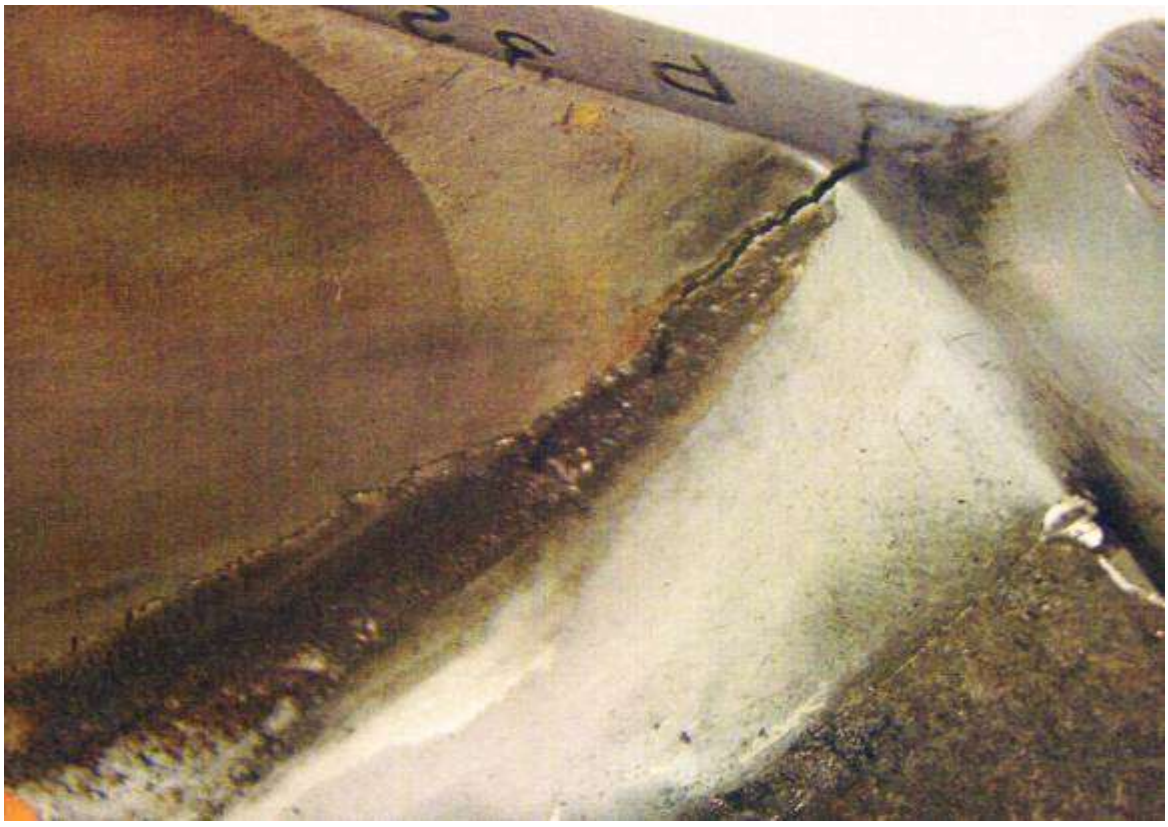

Figure 14.

Therefore it is possible that the technician could not have noticed the micro-crack in the "cast" cylinder without dismantling of the swivel joint during the aircraft maintenance (as provided for in the Service Bulletin SB1131A developed by the aircraft manufacturer in 2016) and had not actually noticed it.

2.3. Aircraft Maintenance Programme

Due to the fact that the aircraft PA-28-140, registration No. YL-JKV, is classified as ELA1 aircraft and is not used for commercial purposes, in accordance with AMC Article M.A.302(h) of explanations of Annex I to Regulation (EU) No 1321/2014, the aircraft owner developed and approved the maintenance programme which included all mandatory maintenances

in order to ensure the continuous airworthiness requirements according to the Minimum Inspection Programmes [AMC M.A.201(e)].

Regardless of whether the aircraft owner has or has not entered into a contract with an airworthiness maintenance management organisation in accordance with Article M.A.201 of Annex I to Regulation (EU) No 1321/2014, the owner shall, in accordance AMC M.A.201(e), declare the technical maintenance programme in conformity with the conditions described therein, therefore, the maintenance programme does not require coordination with the competent authority and the aircraft owner himself or herself performs the annual audit and changes in the maintenance programme of the aircraft.

The section "Airworthiness Directives Related to Aircraft Maintenance" of the maintenance programme include Airworthiness Directive AD No 2005-0035 of the European Aviation Safety Agency (EASA) of 30 December 2005 which is related to the Service Bulletin SB1131. Application of the Service Bulletin SB1131 without requesting dismantling of the swivel joints during inspection of the "cast" torque link lugs (ear) led to not detecting the potential damages and cracks, therefore, objective preconditions for an aircraft serious incident emerged.

Thus, on one hand during the use of the aircraft PA-28-140, registration No. YL-JKV, in accordance with Article M.A.302 of Annex I to Regulation (EU) No 1321/2014 it is specified that the audit of the aircraft maintenance programme and corrections thereto must be made, taking into account new or changed maintenance conditions which have been issued by holders of type-certificate and supplemental type-certificates, etc., as well as it is specified in AMC M.A.302(h) that recommendations of the holder of type-certificate regarding changes in the aircraft maintenance programme which were not initially introduced must be introduced.

However, on the other hand, it is specified in section 2(g) of Sub-paragraph 5.1 of Paragraph "Continuing Airworthiness Arrangement" of Appendix I to Regulation (EU) No 1321/2014 that the conditions must be respected for maintaining the continuing airworthiness of the aircraft, organising that all applicable Airworthiness Directives (EASA) are applied. In accordance with AMC M.A.301(7) of Regulation (EU) No 1321/2014 such maintenance documents as Service Bulletins, service letters, and other information from the aircraft type manufacturer are classified as non-mandatory information.

Therefore, the Airworthiness Directive AD No. 2005-3005 of the European Agency does not provide for the performance of changes in the aircraft maintenance programme in accordance with the Service Bulletin SB1131**A** (which supersedes the Service Bulletin SB1131 in its entirety) in order to improve the aircraft maintenance and to preclude the detection of the potential cracks and fractures in the "cast" main landing gear cylinders during maintenance.

3. CONCLUSIONS

3.1. Results of the Inspection

- the aircraft had a valid Registration Certificate and Airworthiness Review Certificate;
- upon piloting, the pilot complied with the recommendations of the aircraft manufacturer;
- the actual takeoff mass of the aircraft did not exceed the maximum permissible mass specified in the technical documentation of the manufacturer;
- the qualification marks, flight skill tests and periods of validity of the pilot conform to the current requirements of the regulatory documents in the field of civil aviation;

- the damage to the right-hand landing gear oleo strut cylinder of the aircraft formed during the use and is not related to piloting;

- it is specified in the aircraft maintenance documentation that maintenance of the aircraft must be performed according to the Maintenance Manual of the manufacturer and the maintenance programme;

- the maintenance programme was developed and approved by the aircraft owner who also performed audits of the aircraft maintenance programme and made changes therein;

- the maintenance of the aircraft was performed by a certified technical specialist;

- the inspection of the "cast" main landing gear strut cylinders was performed without dismantling of the swivel joint in accordance with the requirements of the Service Bulletin SB1131;

- the maintenance of the "cast" main landing gear strut cylinders in accordance with the Service Bulletin SB1131 was inefficient and had not allowed the technician to detect the potential hidden damages;

- the aircraft maintenance programme does not provide to improvement of the maintenance according to the latest technical recommendations of the aircraft type manufacturer without the issuance of the EASA Airworthiness Directives.

3.2. Causes of the Aircraft Serious Incident:

3.2.1. Direct Cause of the Aircraft Serious Incident

Metal fatigue of the "cast" landing gear strut cylinder during the use.

3.2.2. Main Cause of the Aircraft Serious Incident

Non-application of the Service Bulleting SB1131A of the aircraft manufacturer during the performance of the aircraft maintenance.

3.2.3. Causes Facilitating the Aircraft Serious Incident

- Repeated impact of loads on torque link lugs (ear) during the use of the aircraft;
- The method used in inspection of the "cast" cylinder.

4. SAFETY RECOMMENDATIONS

It has been detected during the safety investigation that the cause of the aircraft serious incident was non-application of the Service Bulleting SB1131A of the aircraft manufacturer during performance of the aircraft maintenance because inspection of the swivel joint from the outside only increases the risk of not noticing the signs of disintegration in the landing gear strut which might, possibly, occur during the use of the aircraft. Therefore, the Transport Accident and Incident Investigation Bureau is addressing the following safety recommendation to the aircraft owner as the operator who is responsible for the flight safety and maintenance of the aircraft:

Recommendation LV2019001
Improve the maintenance procedure of the aircraft PA-28-140, registration No YL-JKV, with additional activities in accordance with the Service Bulletin **SB 1131A** of the aircraft manufacturer Piper Aircraft Inc.

It was detected during investigation that the main cause of the aircraft serious incident was non-application of the latest recommendations of the aircraft manufacturer during performance of the aircraft maintenance because the air operator performed the maintenance according to the Airworthiness Directive 2005-0035 which does not reflect the recommendations of the aircraft manufacturer for improvement of the maintenance. Therefore, the aircraft maintenance had been performed without conforming to the recommendation of the aircraft manufacturer and during it the signs of disintegration of the landing gear strut had not been noticed. In order to preclude such deficiencies in the maintenance of such aircraft type in the future, the Transport Accident and Incident Investigation Bureau is addressing the following safety recommendation to the European Aviation Safety Agency (EASA):

Recommendation LV2019002
Revise the Airworthiness Directive 2005-0035 according to the recommendations of the aircraft manufacturer due to the main cause of the aviation serious incident of the aircraft PA-28-140 which is related to deficiencies in the regulatory documents of the aircraft maintenance.

Riga, 1 July 2019

Investigator in Charge	Vilis Ķipurs
Head of the Aviation Accident and Investigation Investigation Department	Visvaldis Trūbs
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