MINISTRY OF TRANSPORT, CONSTRUCTION AND REGIONAL DEVELOPMENT OF THE SLOVAK REPUBLIC
Aviation and Maritime Investigation Authority
Nám. slobody 6, P.O.BOX 100, 810 05 Bratislava 15

Reg. No. SKA2012003

F I N A L R E P O R T

on investigation of air accident

of aircraft **DIAMOND DA40-180,**

Registration No. **OM–KLO**

Date: 01.05.2012

Place: Airport of Holíč / LZHL

A. INTRODUCTION

The investigation of air accident, serious incident, has been conducted pursuant to Art. 18 of the Act No 143/1998 on Civil Aviation (Civil Aviation Act) and on Amendment of Certain Acts and in accordance with the Regulation (EU) No. 996/2010 of the European Parliament and of the Council on investigation and prevention of civil aviation accidents and incidents, governing the investigation of civil aviation accidents and incidents.

The final report is issued in accordance with the Regulation L 13 that is the application of the provisions of ANNEX 13 Air Accident and Incident Investigation to the Convention on International Civil Aviation.

The exclusive aim of investigation is to establish causes of accident, serious incident, and to prevent their occurrence, but not to refer to any fault or liability of persons.

This final report, its individual parts or other documents related to the investigation of the air accident in question have an informative character and can only be used as recommendation for the implementation of measures to prevent occurrence of other air accidents and serious incidents with similar causes

Operator / Owner:	SEAGLE AIR – FTO s.r.o. Záhumenská 6672/60 911 01 Trenčín
Type of operation:	general aviation – flying school FTO
Type of aircraft:	DIAMOND DA 40-180
Registration No.:	OM–KLO

Take-off site:	Airport LZTN
Flight phase:	taxiing after landing at the Airport LZHL
Place of accident:	runway LZHL
Date and time of accident:	01.05.2012, 13 h 15 min

Note: All time data in this report are stated in the UTC time.

B. INFORMATIVE SUMMARY

On 1 May 2012 at 13:00 the pilot of aircraft was making a navigation flight on the route from the Airport LZTN to the Airport LZHL. In his statement the pilot said that after landing he had been taxiing back on the runway („RWY“) to the parking area of the aero club of LZHL. Approximately in the second third of the runway the tube of front landing-gear leg broke. Its breaking caused damage to the propeller and forced engine shutdown.

Specialised board appointed for investigation of the air accident:

Jaroslav Juszczuk - chairman of investigation Board
Ing. Igor Benek - member of investigation Board.

The report is issued by:

Aviation and Maritime Investigation Authority
of the Ministry of Transport, Construction and Regional Development
of the Slovak Republic

C. MAIN PART OF REPORT

1. FACTUAL INFORMATION

1.1 History of the flight

The flight history was ascertained from statements of the pilot of aircraft and witnesses – members of the local aero club, as well as by inspection of the aircraft and its damage.

On 1 May 2012 at 13:00 the pilot of aircraft made a navigation flight on the route from the Airport LZTN to the Airport LZHL. Meteorological conditions were suitable for the flight. In view of the conditions at the airport of destination the pilot decided to land on RWY 18 of the Airport LZHL. In his statement the pilot said that he had decided to land on small landing flaps and after the landing he had taxied on RWY back to the parking area used by the aero club of LZHL. In the second third of the runway the tube of front landing-gear leg broke. Its breaking caused damage to the propeller and forced engine shutdown.

In their description of the landing the witnesses stated that the flare-out had been made correctly in normal altitude and that the aircraft had landed on RWY 18 without disturbing moments, without contact of the front landing-gear and without the aircraft bouncing after the landing.

Daytime: day
Flight rules: VFR

1.2 Injuries to persons

Injury	Crew	Passengers	Other persons
Fatal	-	-	-
Serious	-	-	-
Minor	-	-	-
None	1	-	

1.3 Damage to aircraft

Breakage of tube of the front landing-gear leg

Breakage of fork and wheel of the front landing-gear

Breakage of the front landing-gear leg, damage to propeller and engine of aircraft

Damage to propeller and engine caused by violent stoppage when the propellertouched the ground.

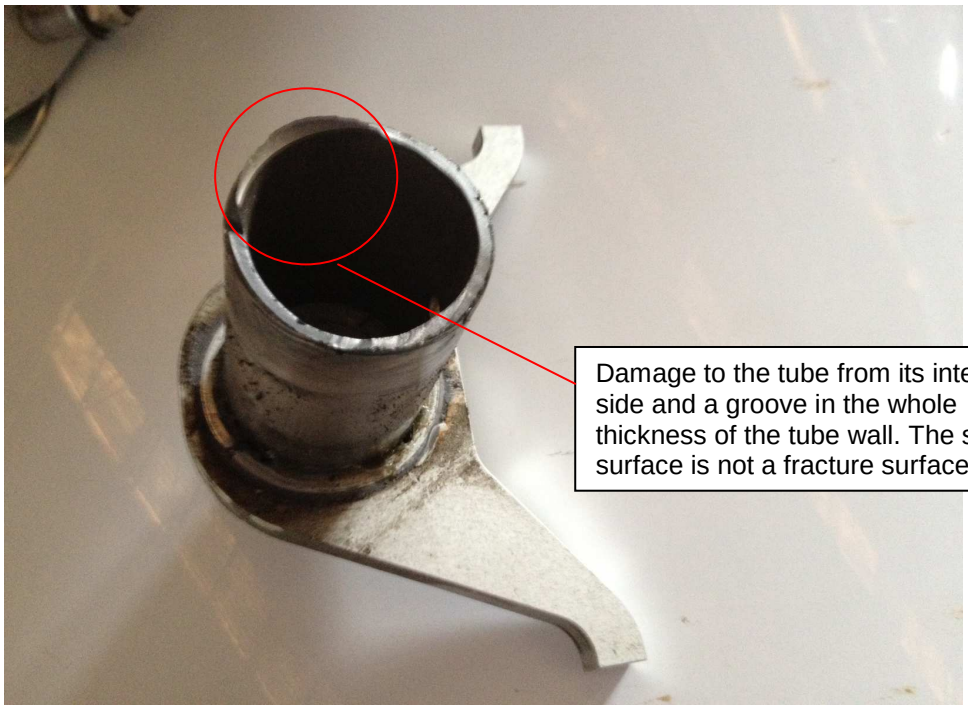
Technical inspection of aircraft after accident

The inspection of the tube of frong landing gear (P/N D41-3223-10-00-1) detected the following facts:

The steel tube of landing gear at the point of cranking – joint was broken in full profile, which caused the breaking off of the fork with wheel of front landing-gear leg.

More detailed inspection showed that the said tube was damaged on the internal side - groove almost in the whole thickness of the tube wall. The groove surface was provided with the same surface finish as the internal wall of the tube.

The damage to the tube wall seemed to be an error in construction of the landing-gear tube. After detection of this error the tube was sent for expertise to the Institute of Criminology and Expertise of the Police of SR.



1.4 Other damages

The Aviation and Maritime Investigation Authority was not informed about circumstances with potential application of other claims for compensation of damages towards a third party.

1.5 Personnel information

Pilot:

Citizen of SR, aged of 47 years,

holder of the pilot licence PPL(A) No. SK 02100008, issued by LAA SR on 27.01.2010 with marked validity until 27.01.2015.

Medical certificate of 2nd class with marked validity until 06.07.2013.

Qualifications:

SEP(L) for type DIAMOND DA 40 with marked validity until 31.01.2014.

Flying experience:

Pilot has had flying experience from the year 2010

With aircraft, total:	211 hours	597 flights
For the last period:	7 hours	26 flights
With type DA40 total:	14 hours	

1.6 Aircraft information

Type:	**DIAMOND DA40-180**
Registration No.:	OM-KLO
Serial No:	40.489
Year of manufacture:	2005
Manufacturer:	Diamond Aircraft Industries Inc., Canada

Certificate of airworthiness No. 1024/1, issued by LAA SR on 11.06.2010 with marked validity until 12.05.2011 and prolonged on 09.05.2011 (SK.MG.021) until 11.05.2012.

Total operating hours :	1090 h 35 min
Total number of takeoffs:	1734
Release into operation:	CRS No. 14.02.2012/OM-KLO, on 24.02.2012, 1002 h 35 min

1.7 **Meteorological situation**

Meteorological conditions had no influence on the occurrence of the accident.

1.8 **Aids to navigation**

Not applicable.

1.9 **Communications**

The aircraft was equipped by radio communication system enabling two-way communication with all air stations at every moment of the flight .

1.10 **Aerodrome information**

The Airport LZHL is a private-flying grass domestic aerodrome with dimensions 1200*100 m, RWY 04/22.

1.11 **Flight recorders and other recorders**

Not applicable.

1.12 **Wreckage and impact information**

Position of aircraft – runway of LZHL in the direction to the parking area.

1.13 **Medical and pathological information**

Not applicable.

1.14 **Fire**

Not applicable.

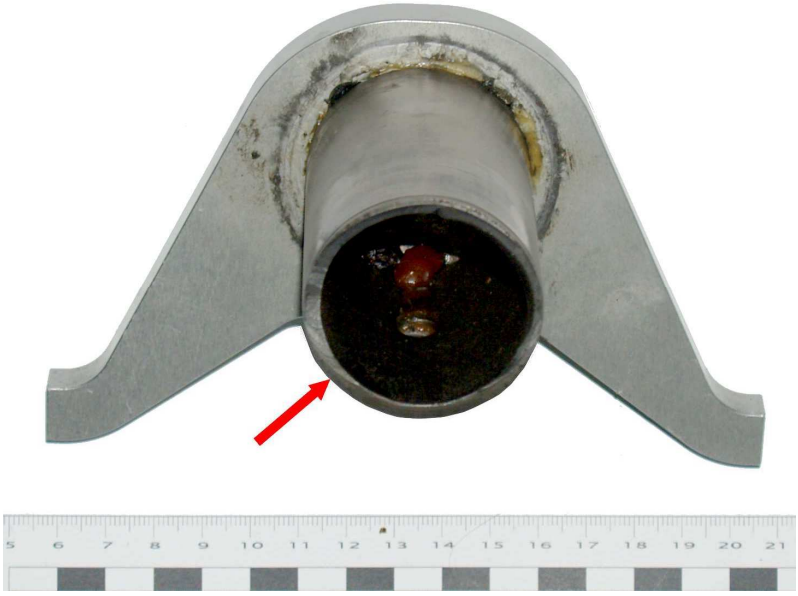
1.15 **Survival aspects**

Not applicable.

1.16 **Tests and research**

During investigation of causes of the air accident the damaged section of front landing gear was examined by experts who issued an opinion regarding the fracture and determined the mechanism of its occurrence.

A fracture was detected across the entire circumference of submitted hollow axle with external diameter Ø 45 mm and wall thickness of 3.5 mm (fig.1).



Examination of fracture detected the following:

a) fatigue fracture was initiated on two opposite sides of the circumference of the axle (see the positions of black arrows on figure 2). One side of the axle showed much larger scope of fatigue damage – the lower main part of fatigue fracture shown on figure 2 covered about a half of total fracture surface, while the upper part of fatigue fracture accounted for a small part of the total fracture surface (see the distribution of fatigue fracture and the area of final rupture of material (fig. 2).

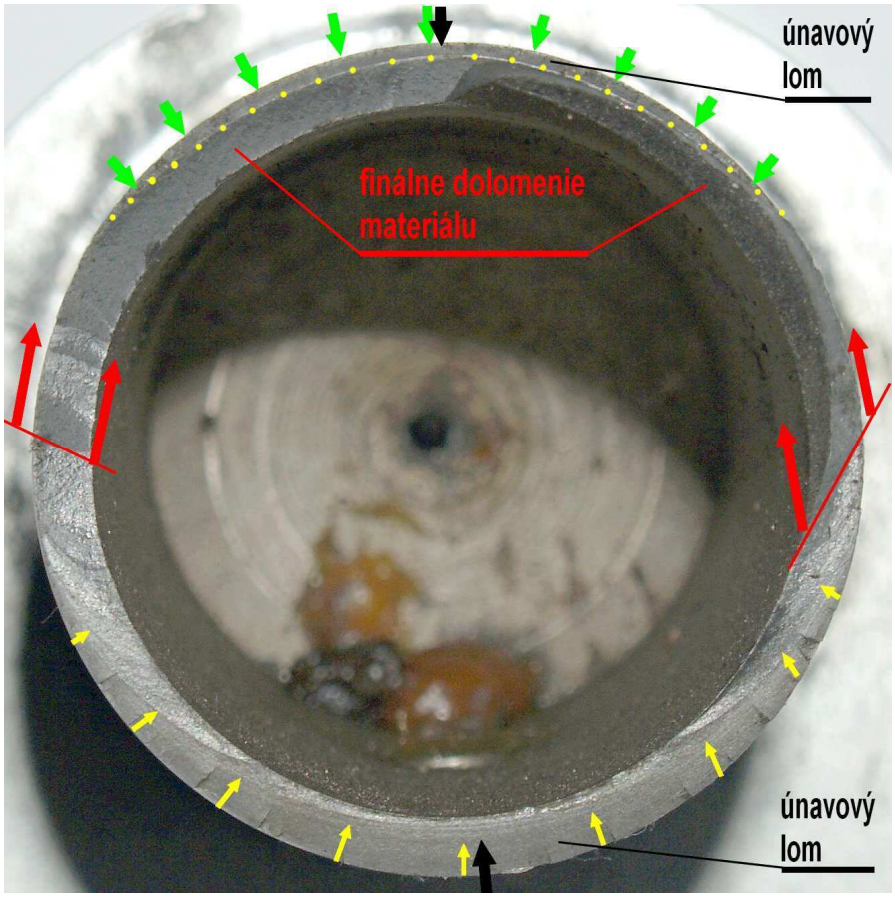


Fig. 2 Overall view of fracture surface on the axle

b) in the initial phase the fatigue fracture increased very slowly and its progressive formation was not grossly visible. With gradual reduction of the carrying section of the axle wall the fracture progressed faster and bands of its propagation started to be visible also by standard macrographic examination (fig. 3),

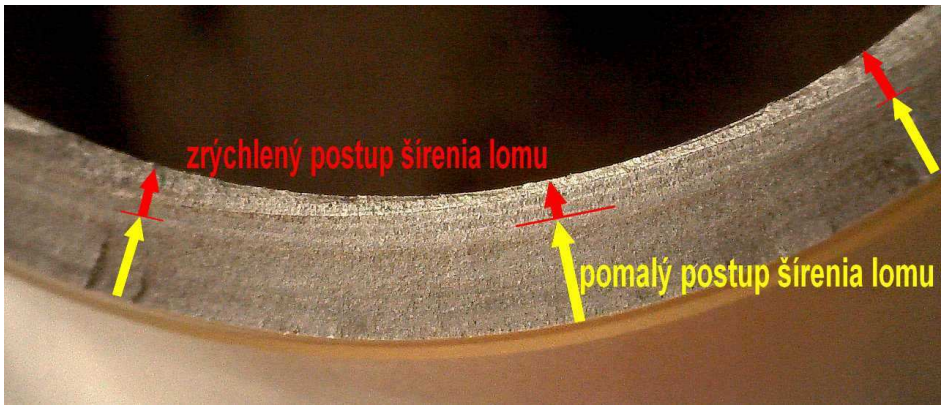


Fig. 3 Main part of fatigue fracture and visible differences in the speed of fracture propagation

c) the smaller opposite part of fatigue fracture did not make it to pass through the whole axle wall and a major part of the material section in this area of axle was damaged by the mechanism of final material rupture (fig. 4a, fig. 4b and fig. 4c).

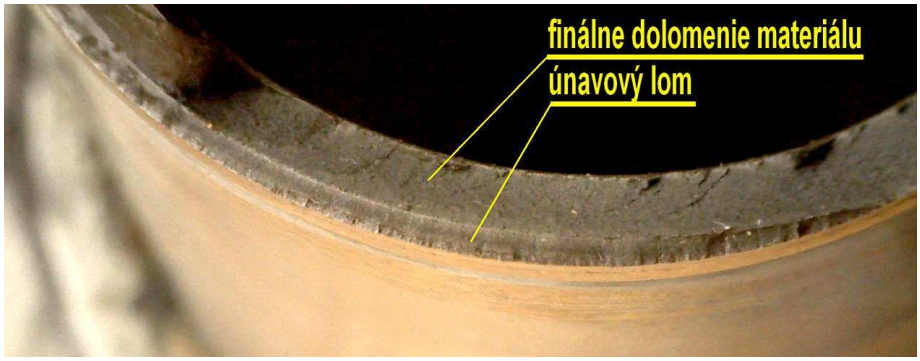


Fig. 4a Smaller opposite part of fatigue fracture and bevelled area of final material rupture

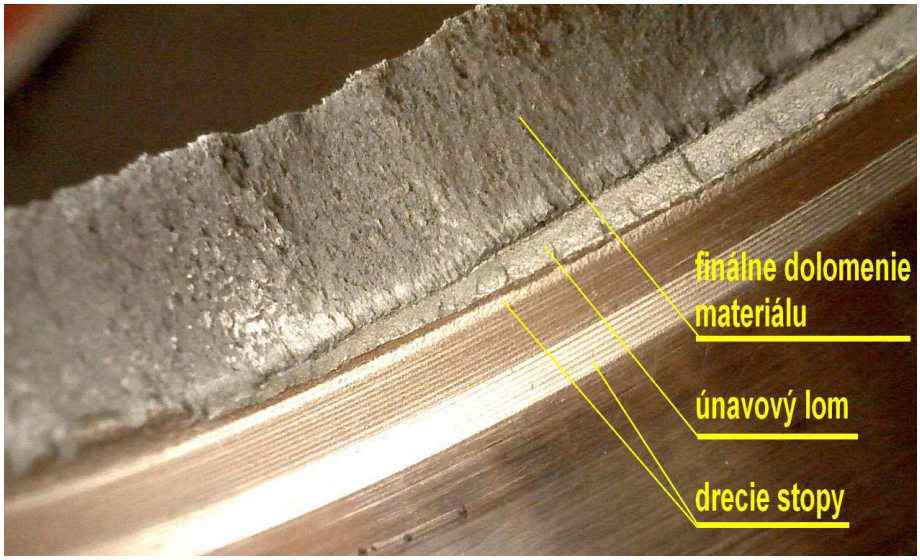


Fig. 4b Smaller opposite part of fatigue fracture and steep-incline area of final material rupture.

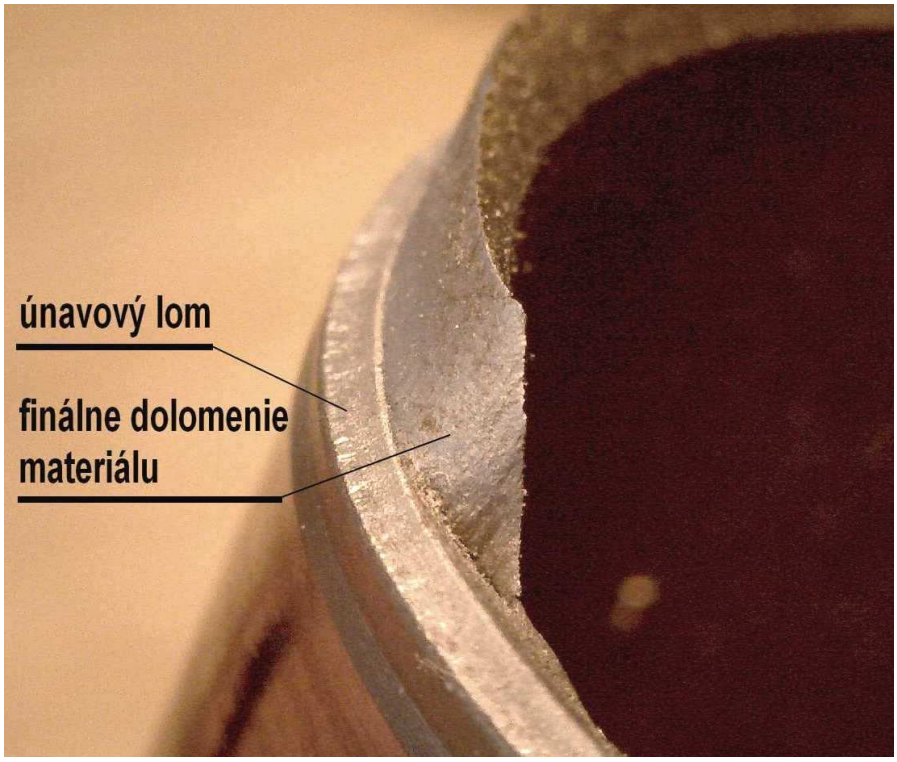


Fig. 4c Side view of the area of final material rupture with visible steep inclination of fracture surface

d) In the area of development of fatigue fracture abrasion marks were found on the peripheral wall of the axle (see fig. 4b). These marks represented certain continuous micro damage to the axle surface, which served as stress concentrators in the upper layer of the axle within the triggering mechanism of fatigue process of material damage.

e) the existence of two opposite sections of fatigue fracture with different size proves that the axle was exposed to alternate variable stress, where amplitudes of stress in one direction were much larger and probably more numerous than amplitudes of stress in the opposite direction (F » FI - fig. 5),

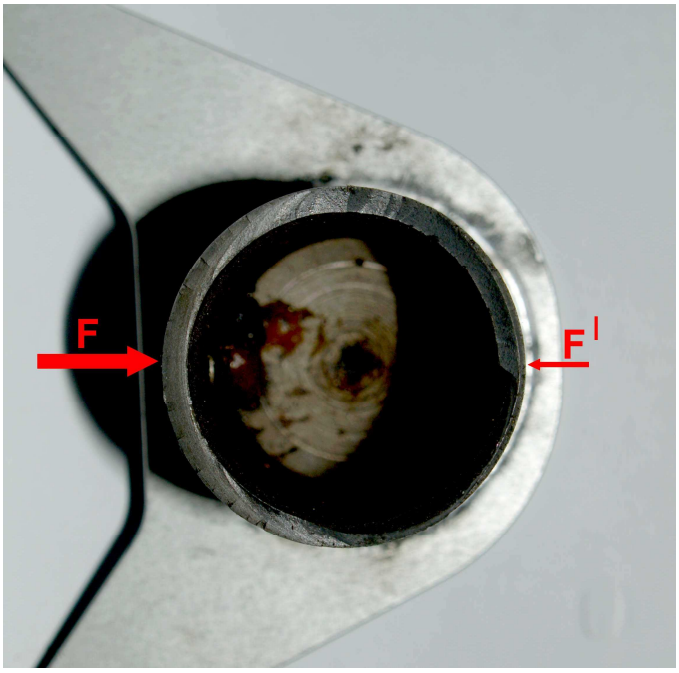


Fig. 5 Direction of forces loading the axle upon formation and development of fatigue fracture

f) the position in which the axle had been mounted (against the direction of movement of aircraft or against the direction of action of gravitational forces) was unknown at the time of examination of submitted mark.

- if forces F and FI (fig. 5) acted in the horizontal plane or the force F slantly upwards, this loading stems from impacts of the wheel to obstacles and bumps of natural landing surfaces (large clumps on grass surfaces of airports, etc.).

- if contemplated forces F and FI acted in the vertical plane, damage to the axle would be triggered by impacts of the wheel on the solid subbase during landing of aircraft on the runway.

From the fact that a large part of the fatigue fracture is practically smooth without visible progress bands it results that the fracture occurred at a large number of loading cycles (so-called high-cycle fatigue) and relatively low normal load. From this perspective the variant a) is much more probable than variant b). A much larger number of impacts of the wheel to bumps on natural runways (at start or lading of aircraft) as compared with vertical dynamic forces during aircraft landing can be namely expected.

g) Steep gradients of fracture surfaces in the area of final material rupture are not caused by occurrence of a material anomaly in these areas. They were formed in this shape due to damage caused to the material in the final phase by shear mechanism at so-called bending pressure.

1.17 **Organizational and management information**

The flight of aircraft was in accordance with the training curricula of the flying school.

1.18 **Additional information**

Not applicable.

1.19 **Useful or effective investigation techniques**

Standard investigation methods were used.

2. ANALYSIS

The airworthiness of aircraft was managed by „G“ authorized organisation which managed the airworthiness and performance of maintenance of this aircraft in accordance with recommendations of its manufacturer – holder of the type certificate and issued SB and AD of the said aircraft type.

The aircraft was subject to the implementation of binding decisions and service bulletins for checks of landing gear. Problems with the landing gear were declared by issue of binding decision of EASA AD No. 2009-0016 and in accordance with Binding Service Bulletin No. MSB40-046/3 laying down the conditions of periodical checks of landing gear. The checks were carried out in authorized organization and are recorded in technical documentation of the aircraft.

In view of the fact that the tube was damaged from its internal side, the damage could not be detected by standard defect methods implemented in the service organization.

The material of damaged axle was exposed to alternate variable stress, where amplitudes of stress in one direction were much larger and probably more numerous than amplitudes of stress in the opposite direction. In the area of development of fatigue fracture surface microdamages (abrasion marks) were found on the peripheral wall of the axle, which served as stress concentrators in the upper layer of the axle within the triggering mechanism of fatigue process of material damage.

In the initial phase the fracture occurred due to the mechanism of high-cycle fatigue at low nominal load. The gradual weakening of the axle section in the damaged area under operation of the same forces caused a higher nominal load of the material and hence faster progress of fracture. When the process of weakening of the axle section reached a phase where nominal load in the material reached or exceeded the strength limit of the axle material, the final rupture of the axle occurred.

3. C O N C L U S I O N S / CAUSE OF AIR ACCIDENT

3.1 Findings

Aeronautical technics:

- the aircraft had a valid certificate of airworthiness.
- the maximum takeoff weights were not exceeded.
- binding decisions AD and SB for maintenance of airworthiness of aircraft were implemented.
- maintenance was carried out by authorized organization in line with requirements of the holder of aircraft type certificate.
- the aircraft fulfilled all technical requirements and was ready for the flight in question.
- the aircraft was subject to the implementation of binding decisions concerning the landing gear in question, i.e. AD No: 2009-0016 in accordance with binding decision SB No. MSB40-046/3 on checks of the landing gear, CRS of 14-2-2012 SEAGLE TRADE, s.r.o (SK.MF.014).

Crew of aircraft:

- the state of validity of pilot´s licences and authorizations for the flight in question was documented, without findings.

3.2 Cause of air accident:

Fatigue fracture of submitted hollow axle of front landing-gear leg.

4. SAFETY RECOMMENDATIONS

On the basis of investigation of causes of the air accident

which occurred on 01.05.2012

we recommend:

to the operator of SEAGLE AIR – FTO s.r.o.:

To implement its own measure to enhance regular checks and to keep records beyond the scope of the binding decision of EASA AD 2009-0016
and in accordance with the procedure of the binding bulletin of DAI MSB40-046/3 (DAI MSB D4-046/3)

in cases where the aircraft operation is implemented prevailingly from a non-reinforced grass RWY, where a larger number of impacts of the front wheel to bumps of natural RWY may cause fatigue fracture and subsequent rupture of the front landing-gear axle of aircraft.

Bratislava, 04.09.2012