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Swiss Transportation Safety Investigation Board STSB

Summary Report

A summary investigation, in accordance with Article 46 of the Ordinance on the Safety Investigation of Transport Incidents from 17th December 2014 (OSITI), as of 1st September 2023 (SR *742.161*) was carried out with regards to the serious incident. The sole purpose of an accident or serious incident investigation is the prevention of accidents or serious incidents. It is expressly not the purpose of the safety investigation and this report to determine fault or liability. If this report is used for purposes other than accident prevention, this fact must be taken into account.

The German version of this report is the original and therefore authoritative.

Aircraft	Diamond Aircraft DA40 NG				HB-SGD
Operator	Motorfluggruppe Zürich, Postfach, 8058 Zürich				
Owner	Motorfluggruppe Zürich, Postfach, 8058 Zürich				
Pilot	Swiss citizen, born 1981				
License	Air Transport Pilot License – ATPL(A) with Instrument Rating – IR(A) according the rules of the European Union Aviation Safety Agency (EASA), issued by the Federal Office of Civil Aviation (FOCA)				
Flying experience	**total**	6172:10 h	**during the last 90 days**	13:56 h	
	on type	53:17 h	**during the last 90 days**	12:56 h	
Location	Bern-Belp Airport (LSZB)				
Coordinates	---		**altitude** ---		
Date and time	25 February 2022, 12:17 LT (LT[1] = UTC[2] + 1 h)				
Type of operation	Private				
Flight rules	IFR)				
Point of departure	Zürich Airport (LSZH)				
Destination	Bern-Belp Airport (LSZB)				
Flight phase	On ground / taxing on ground				
Occurrence category	Collapse of the nose landing gear				

Injuries to persons	**Crew**	**Passengers**	**Third persons**
Minor	0	0	0
None	1	1	not applicable

Damage to aircraft	Slightly damaged	Nose landing gear, Propeller
Other damage	None	

[1] LT: Local Time

[2] UTC: Universal Time Coordinated

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Factual information

Course of Events

On February 25, 2022, at 11:30 LT, the pilot, together with a passenger, took off with a Diamond DA40 NG aircraft, registered as HB-SGD, from Zurich Airport (LSZH) and flew to Bern-Belp Airport (LSZB). At 12:12 LT, the landing took place without any abnormalities and in good weather conditions. During a turn into the final parking position the nose landing gear collapsed, causing the propeller to touch the ground (ref. Figure 1).

Figure 1: HB-SGD with collapsed nose gear on the apron of Bern-Belp Airport, view direction south.

Aircraft details

HB-SGD was built in 2015 and imported to Switzerland from Norway in May 2018 with 1826 hours of operation. Since then, the aircraft has been operated by the Motorfluggruppe Zürich. On November 5, 2021, at 3293 operating hours, the last 100-hour inspection was certified. At the time of the serious incident, the HB-SGD had a total of 3370 operating hours and about 7000 landings. Exact data on the operation of the aircraft and maintenance work carried out on the aircraft at times in Norway are not known.

Findings on the nose landing gear

The nose landing gear consists of a landing gear leg, an elastomer spring assembly as damper and a nose wheel which can be freely deflected within ± 30° (ref. Figure 2). The landing gear leg is connected to the fuselage of the aircraft by two pivots. This connection is made via plain bearings installed on the fuselage, which accommodate the pivots.

In the present incident, the left pivot failed. According to the manufacturer's drawing, the pivots are made of a low-alloy heat-treatable steel and the surfaces are chemically nickel-plated. The transition radius between the pivot-axle and shoulder is specified as 0.5 mm with a tolerance of +0.0/-0.1 mm.

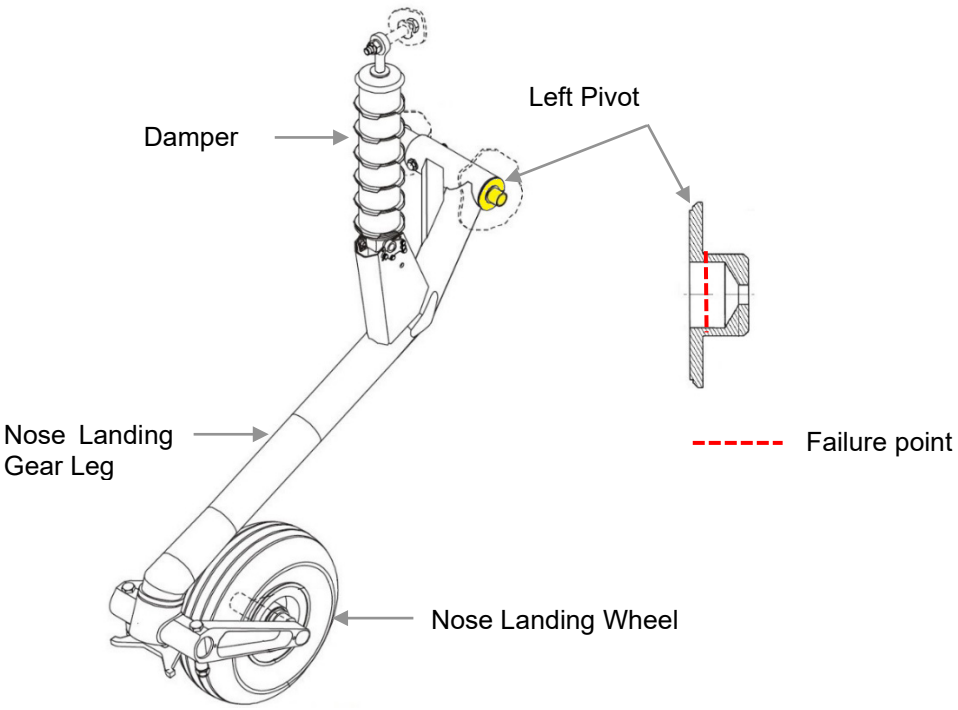

Figure 2: Illustration of the nose landing gear from the aircraft manufacturer's maintenance manual (flight direction to the left). The left bearing pin (marked yellow and additionally shown in section) was broken.

Maintenance instructions

The manufacturer's maintenance specifications in the Aircraft Maintenance Manual (AMM) provide for visual inspections of the nose gear without disassembly work. The bearing journals are not visible. The axial clearance of the landing gear leg at the plain bearings is to be checked every 100 hours of operation. Service life limits are not provided.

The AMM also points out that nose wheel shimmy can occur if the friction of the nose wheel control is too low. After the occurrence of a nose wheel shimmy, the friction should be adjusted by tightening the nut of the nose wheel fork with the necessary tightening torque.

Metallurgical investigation

The fracture of the left pivot occurred at the transition radius between the pivot and shoulder. The fracture surface had two large fracture initiation zones and was partially corroded. Within these zones, steps were present, which can be interpreted as individual fatigue fracture initiations. The area of these zones was clearly larger than the residual ultimate fracture zones (ref. Figure 3).

Further examination of the fractured journal showed that the material was a low-alloy quenched and tempered steel, as specified by the manufacturer, and that the transition radius was 0.5 mm. The right bearing journal was inspected at the transition radius by means of dye penetrant testing; no cracks were detected.

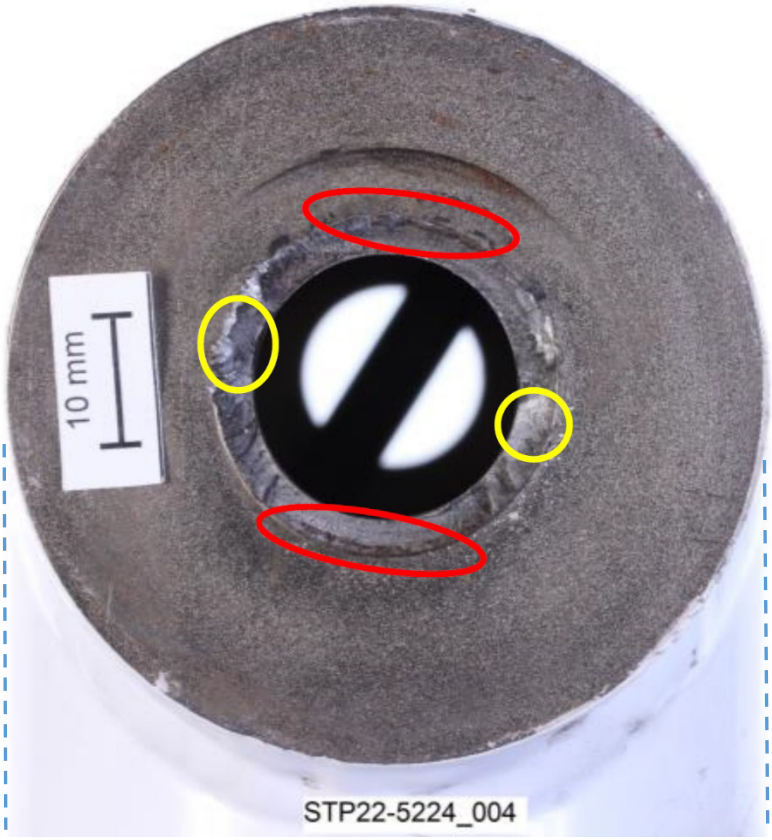

Figure 3: landing gear leg (area between the dashed lines) with its annular surface of the pivot shoulder with the failed section. The fracture surface has large fracture initiation zones (marked in red) and small ultimate fracture zones (marked in yellow).

Comparable events

On the sister aircraft HB-SGV, which is operated by the same operator, a preventive crack inspection was carried out on the pivots of the nose landing gear following the occurrence of nose wheel shimmy and the associated repair work. This revealed evidence of cracks in the area of the transition radius on the left pivot. The nose gear leg was then replaced with a new part.

Analysis and conclusions

The serious incident, in which the nose gear collapsed during taxiing and the propeller touched the ground, was caused by a fatigue failure of a pivot. According to the corrosion traces on the fracture surfaces, the fatigue-related initial damage had occurred over a longer period of time. The location of the fracture initialization zones indicates an alternating bending stress on the nose landing gear, as it can occur due to nose wheel shimmy.

Bern, 28. September 2023 Swiss Transportation Safety Investigation Board