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Swiss Transportation Safety Investigation Board STSB

Aviation Division

Final Report No. 2259 by the Swiss Transportation Safety Investigation Board STSB

concerning the accident involving the CSA Sportcruiser aircraft, registration HB-WYC,

on 26 May 2014

at Lommis airfield / TG

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Ursachen

Der Unfall ist auf einen Bruch der vorgeschädigten Lenkachse des Bugfahrwerks während der Landung zurückzuführen.

Folgende Faktoren haben zu den vorbestandenen Schäden beigetragen:

- unzweckmässige Konstruktion des Bugfahrwerks;
- Anflüge mit überhöhter Geschwindigkeit;
- häufiger Einsatz auf einer Graspiste.

General information on this report

This report contains the Swiss Transportation Safety Investigation Board's (STSB) conclusions on the circumstances and causes of the accident, which is the subject of the investigation.

In accordance with Article 3.1 of the 10th edition, applicable from 18 November 2010, of Annex 13 to the Convention on International Civil Aviation of 7 December 1944 and Article 24 of the Federal Air Navigation Act, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident/incident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All information, unless otherwise indicated, relates to the time of the accident.

All times in this report, unless otherwise indicated, are stated in local time (LT). At the time of the accident, Central European Summer Time (CEST) applied as local time in Switzerland. The relation between LT, CEST and UTC is:
LT = CEST = UTC + 2 hours.

Final report

Aircraft type	CSA Sportcruiser	HB-WYC
Operator	Motorfluggruppe Thurgau, Aerodrome, 9506 Lommis	
Owner	Motorfluggruppe Thurgau, Aerodrome, 9506 Lommis	

Flight instructor	Swiss citizen, born 1982				
Licence	Air transport pilot licence (ATPL(A)) according to the European Aviation Safety Agency (EASA), issued by the Federal Office of Civil Aviation (FOCA)				
Essential ratings	Flight instructor (FI(A)) Single engine piston – SEP				
Flying hours	**Total**	4905 hours	**During the last 90 days**	210:05 hours	
	On the type involved in the accident	13:27 hours	**During the last 90 days**	6:37 hours	

Trainee pilot	Swiss citizen, born 1984			
Licence	Multi-crew pilot licence (MPL(A)) according to EASA, issued by the FOCA			
Essential ratings	None			
Flying hours	**Total**	1737 hours	**During the last 90 days**	134:26 hours
	On the type involved in the accident	3:51 hours	**During the last 90 days**	3:51 hours

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Location	Lommis airfield (LSZT)		
Coordinates	---	**Elevation**	---
Date and time	26 May 2014, 11:41		

Type of operation	VFR, training
Flight phase	Landing
Type of accident	Landing gear fracture

Injuries to persons	None
Aircraft damage	Slightly damaged
Other damage	Minor damage to the field

1 Factual information

1.1 Flight preparations and history of the flight

1.1.1 General

The statements of the crew and recordings from the Flarm collision avoidance system and the electronic flight instrument system (EFIS) D100 were used for the following description of the flight preparations and the history of the flight.

1.1.2 Flight preparations

The trainee pilot held a licence for multi-crew aircraft and intended to acquire a private pilot licence with the rating for single-engine piston aircraft. The necessary training was being carried out in accordance with a Swiss Aviation Training (SAT) training plan[1] within the framework of the Motorfluggruppe Thurgau (MFGT) flying school.

The crew had carried out their first training unit, with a duration of 3:05 hours, on 8 May 2014. For the day on which the accident occurred, 26 May 2014, landing training was scheduled as preparation for solo flights.

At 11:01, HB-WYC took off from grass runway 24 at Lommis airfield (LSZT) for a series of six circuits. These included touch-and-goes (four times), one go-around and one full stop landing. All exercises met with the flight instructor's satisfaction. After a short break with the engine running, as a final exercise before the solo flights, the flight instructor planned to carry out a single circuit featuring an approach with a zero flaps landing.

1.1.3 History of the flight

At 11:37, the Sportcruiser HB-WYC took off from runway 24 for a single circuit. After the uneventful circuit, a few minutes later the aircraft turned onto its final approach, which was, as planned, made without the assistance of the landing flaps.

At the start of the final approach, the airspeed was 71 KIAS[2]. Shortly before landing, at 50 ft above ground, a value of approximately 67 KIAS was indicated (cf. Table **1**). The landing took place at 11:41. According to the flight instructor's statements, the main landing gear touched down approximately 150 m after the runway threshold, followed shortly afterwards by the nose gear. After a further 100 m (approximate) the wheel brakes were first applied. The nose gear collapsed approximately 50 m further on. The nose of the aircraft impacted on the runway and the propeller stopped rotating (cf. Figure 3). The deceleration of the aircraft was so pronounced that both pilots' headsets and spectacles were thrown off their heads.

After the aircraft came to a standstill, the crew shut off the fuel supply, switched off the aircraft's ignition and reported on the aerodrome frequency that the aircraft had had an accident and was on the runway. The crew then also switched off all electrical equipment and vacated the aircraft.

The crew were uninjured. The aircraft was slightly damaged. There was minor damage to the grass on the runway.

[1] Lesson Plan ATPL and MPL extension to PPL/SEP [private pilot licence/single engine piston]

[2] KIAS: knots indicated air speed

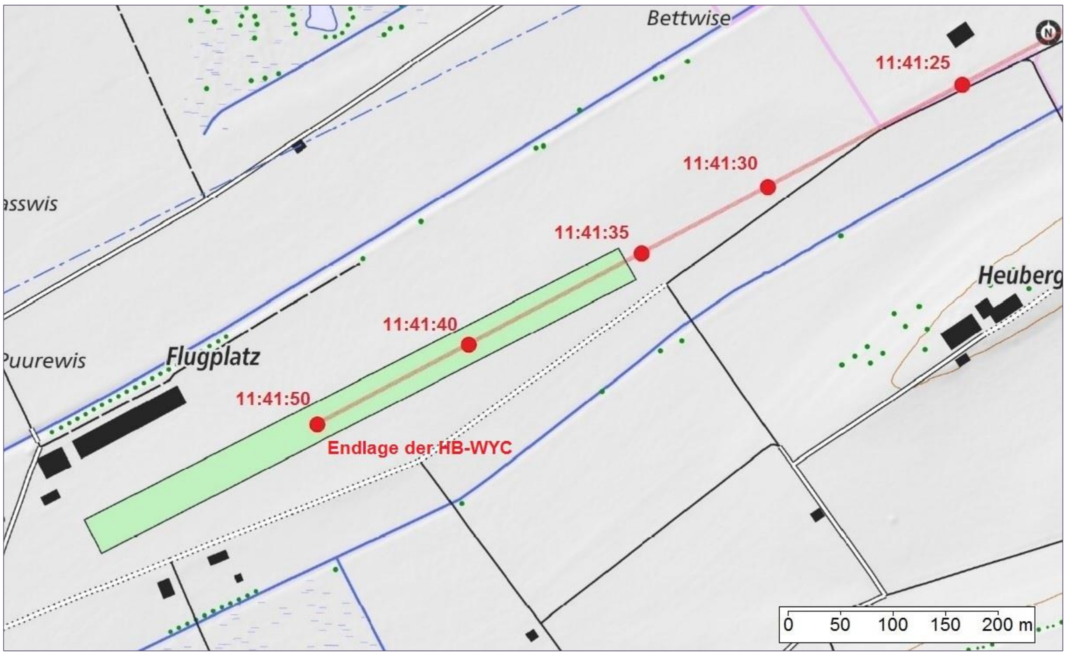

Figure 1: Approach of HB-WYC to grass runway 24 of Lommis airfield and final position of HB-WYC according to the GPS position data recorded by the EFIS[3] (Base map reproduced by permission of the Federal Office of Topography Swisstopo (JA150149)).

1.2 Meteorological information

1.2.1 General weather condition

A flat area of low pressure with multiple nuclei extended from south-east Europe over the Alps to the British Isles. A virtually stationary front extended from the Adriatic over Lake Constance towards northern France.

Dry weather prevailed under extensive clouds at moderate altitudes. At ground level, a light wind was blowing from the western sector.

1.2.2 Aerodrome weather report

The 11:20 aerodrome weather report for the nearby Zurich Airport (LSZH) read:

LSZH 260920Z 28004KT 230V330 9999 FEW025 SCT040 BKN160 17/11 Q1016 NOSIG=

In plain text, this means:

On 26 May 2014 the following weather conditions were observed at Zurich Airport shortly before the time of issue of the aerodrome meteorological report at 09:20 UTC:

Wind	4 knots from 280 degrees varying between 230 and 330 degrees
Meteorological visibility	10 km or more
Precipitation	none

[3] The EFIS records position data at intervals of 5 seconds. This recording, reproduced in local time, is subject to an inaccuracy of approximately 1 second (cf. Section 1.5.3). For 11:41:45 an erroneous position was recorded, so this is not shown in the figure.

Clouds	1/8–2/8 at 2500 ft AAE[4] 3/8–4/8 at 4000 ft AAE 5/8–7/8 at 16,000 ft AAE
Temperature	17 °C
Dew point	11 °C
Atmospheric pressure (QNH)	1016 hPa (pressure reduced to sea level, calculated using the values of the ICAO[5] standard atmosphere)
Trend	No significant changes expected for the next two hours

1.2.3 Astronomical information

Position of the sun at 11:41	Azimuth: 136 degrees Elevation: 57 degrees
Lighting conditions	Daylight

1.3 Aircraft information

1.3.1 General

Registration	HB-WYC
Aircraft type	Sportcruiser
Characteristics	Single-engine two-seater low-wing aircraft of the Ecolight category[6], of metal construction, with fixed landing gear in nose wheel configuration and unsteered swivel caster nose wheel.
Manufacturer	Czech Sport Aircraft (CSA), Kunovice, Czech Republic
Engine	Rotax 912 ULS
Year of manufacture	2009
Serial number	09SC298
Licence	VFR by day
Maximum permitted take-off mass	600 kg
Mass and centre of gravity	At the time of the accident, the mass and centre of gravity were within the permitted limits according to the aircraft flight manual (AFM).
Operating time	837 hours TSN[7], 2369 landings
Technical limitations	No faults or observations were entered in the logbook.

[4] AAE: above aerodrome elevation

[5] ICAO: International Civil Aviation Organisation

[6] Ecolight in accordance with Light Sport Aircraft Statement of Compliance and EASA form 18b No. 0010004452, Issue 24.3.10 (FOCA entry in HB-WYC's technical documentation)

[7] TSN: time since new

Certificate of Registration	Issued by the FOCA on 28 April 2010
Inspection confirmation	Issued by the FOCA on 8 August 2013 at 683:50 hours TSN
Permit to fly	Issued by the FOCA on 8 August 2013, valid till 8 August 2014
Most recent maintenance work	100-hour check on 24 April 2014 at 800:45 hours TSN

1.3.2 Maintenance performed on the nose landing gear of HB-WYC

The nose landing gear of HB-WYC was replaced on 31 May 2012 at a total operating time of approximately 435 hours TSN and 1235 landings, following a landing accident. In compliance with the requirements of the aircraft maintenance manual (AMM) for aircrafts with a serial number up to and including 325, a nose landing gear of modified design was fitted. This was already fitted in the factory as standard on aircraft from serial number 326 upwards.

On 9 October 2013 the manufacturer first published service bulletin SB-CR-016. It required a periodic inspection of the nose landing gear leg for cracking in the area of the welded joint at its lower end (cf. Figure 2). Regarding the background of this requirement, the manufacturer wrote:

"Some SportCruiser / PiperSport PS-28 Cruiser aircraft have developed cracks in the bottom side of the lower section of the nose landing gear (NLG). The cracks develop on the NLG-assembly along the weld of the tube and the bracket. To address this potential condition, an inspection of the bottom side of the lower section, in the place of the weld of the tube and the bracket is required."

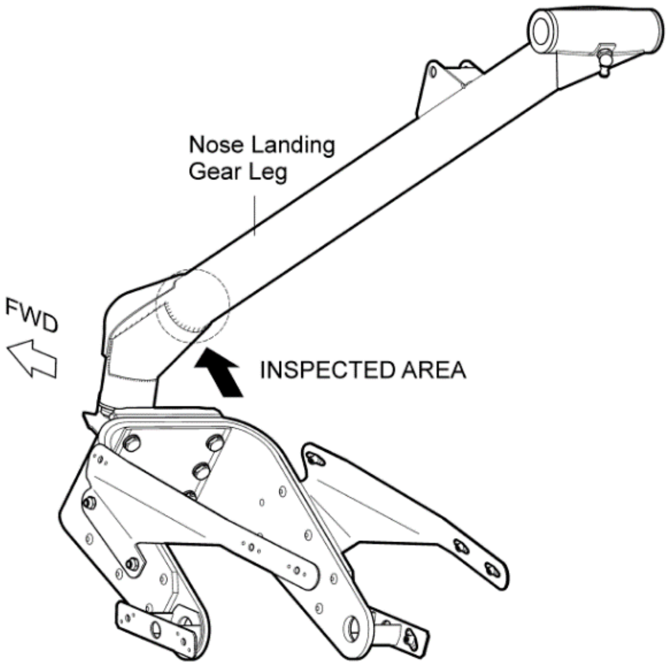

Figure 2: Nose landing gear leg with the area to be inspected for cracks according to service bulletin SB-CR-016

The inspection required by service bulletin SB-CR-016 was carried out most recently on HB-WYC as part of the 100-hour check on 24 April 2014.

1.4 Wreckage and impact information

The aircraft's final position was 310 m after the threshold of runway 24, which has an available runway length of 615 m. The location of the main landing gear's initial contact with the ground could not be determined (cf. also section 1.5). The furrow in the grass runway caused by the broken-off nose gear leg is approximately 17 m long.

Figure 3: Final position of HB-WYC on runway 24 at Lommis airfield

The nose landing gear wheel which was separated from the landing gear leg lay beside the aircraft on the runway. The landing gear leg itself had separated from the aircraft. When the aircraft's nose hit the runway, the nose gear leg penetrated the fuselage and was inside the cockpit in direct proximity to the rudder control pedals (cf. Figure 4).

Figure 4: Cockpit of HB-WYC; the yellow arrow indicates the broken-off leg of the nose landing gear which penetrated the cockpit

1.5 Recording devices

1.5.1 Flarm collision warning device

An altitude profile was generated from the recorded flight path data. This provides an overview of the total of seven aerodrome circuits, with an emergency landing exercise at the beginning of the fifth circuit and the short break on the ground before taking off on the flight which ended with the accident (cf. Figure 5).

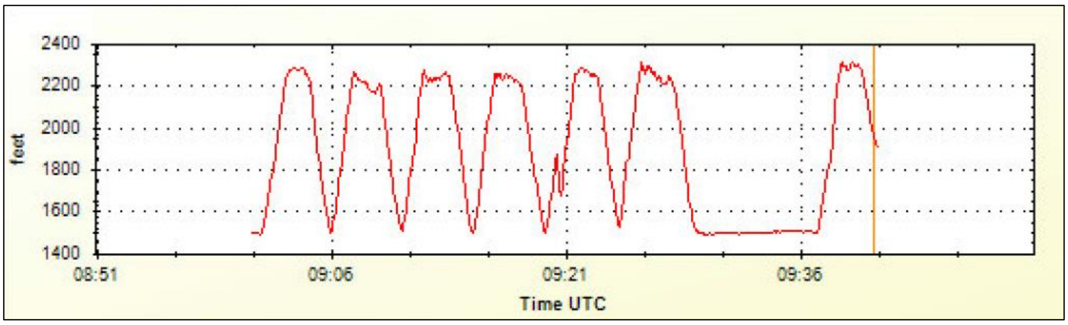

Figure 5: Altitude profile of the flights recorded by the Flarm

The recordings end briefly after the turn into the final approach on the seventh circuit. This is due to a feature of the Flarm which stores flight path data in packets. Since the power supply was interrupted just after the accident, the last data packet could not be saved to the memory anymore.

1.5.2 GPS device

The portable device fitted to the aircraft's instrument panel, a Garmin 296, did not contain any recordings of flight path data. The function provided for this was deactivated and the corresponding memory was empty.

1.5.3 Electronic flight instrument system

The Dynon D100 electronic flight instrument system (EFIS) recorded various flight data parameters at five seconds intervals. The indicated and recorded values for flight attitude (pitch), indicated airspeed, barometric altitude and vertical speed during the final approach up to the time the aircraft came to a standstill are summarised in the table below:

UTC	Pitch [°]	Airspeed [KIAS]	Altitude [ft AMSL[8]]	Vertical speed [ft/min]
09:41:15	2.5	71	1744	-790
09:41:20	-0.5	72	1701	-565
09:41:25	2.8	68	1640	-681
09:41:30	2.9	67	1592	-556
09:41:35	8.9	59	1555	-411
09:41:40	3.3	55	1544	+264
09:41:45	-31.4	35	1575	+896
09:41:50	-20.4	0	1558	-140
09:41:55	-22.5	0	1557	0

Table 1: EFIS data on the final approach and landing

[8] AMSL: above mean sea level

Correlating these values to the GPS position data which was also recorded (cf. Figure 1) is possible only to a limited extent, because the recording of the GPS position data is subject to an inaccuracy of approximately 1 second due to the EFIS. Considering this limitation, at an airspeed of 60 KIAS an additional inaccuracy of approximately 30 m must be expected.

1.6 Medical information

There are no indications of the crew suffering any health problems during the accident flight. A breath alcohol test carried out by the Thurgau cantonal police proved negative for both crew members.

1.7 Examination of the nose landing gear

1.7.1 General

Parts of the nose gear were subjected to a detailed technical materials analysis to determine the cause of the damage. The fractures of the steering axle, the landing gear leg and the attachment points of the nose wheel fairing (cf. Figure 6) were examined.

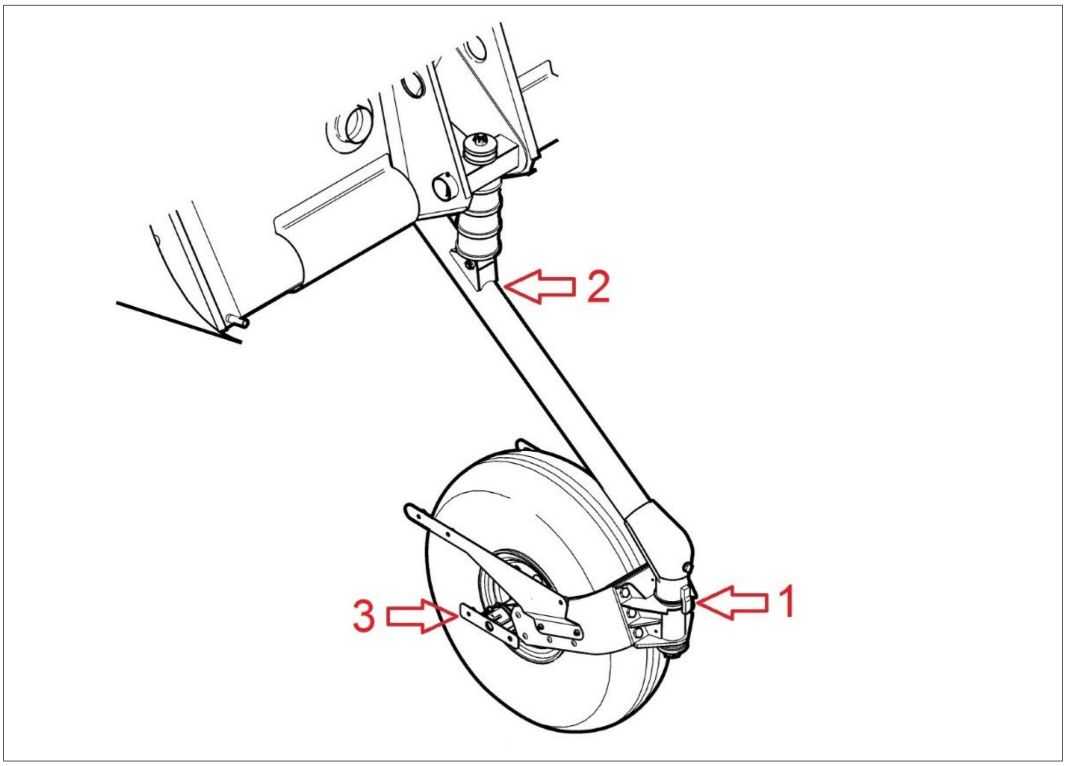

Figure 6: Location of the fractures: steering axle (1), landing gear leg (2) and attachment points of the nose wheel fairing (3)

1.7.2 Steering axle

The steering axle fracture is a fatigue fracture resulting from reversed bending stresses. It is the result of fatigue cracks which grew larger over an extended period, until final failure occurred.

The fracture surface exhibited multiple fracture zones. Based on the beach marks, a forward and an aft crack formation area is evident. The discoloration of the aft fracture zone indicates that this was older than the forward fracture (cf. Figure 7).

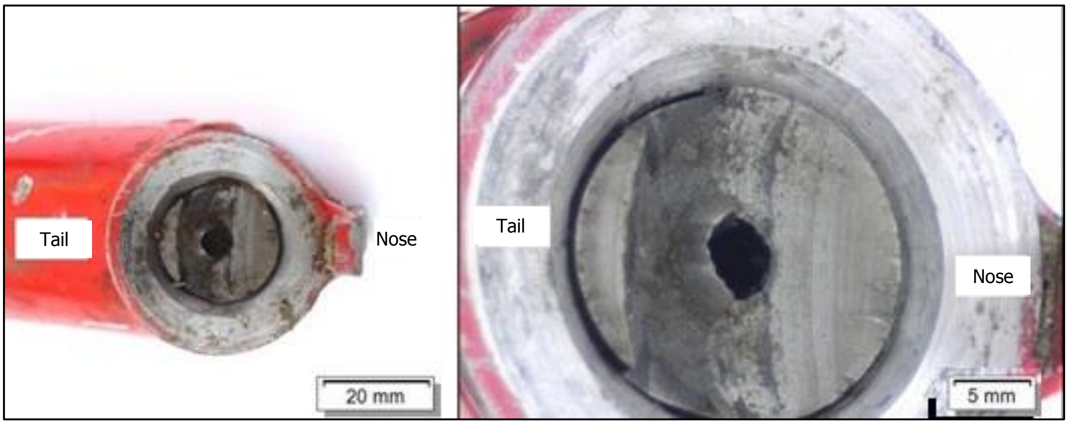

Figure 7: Fracture area of the steering axle

From the longitudinal section through the part of the steering axle above the fracture it can be seen that the position of the steering axle secured in the tube is vertically displaced. Given the extensively deformed retention bolt, a large force must have been applied to result in such a displacement of the steering axle (cf. Figure 8).

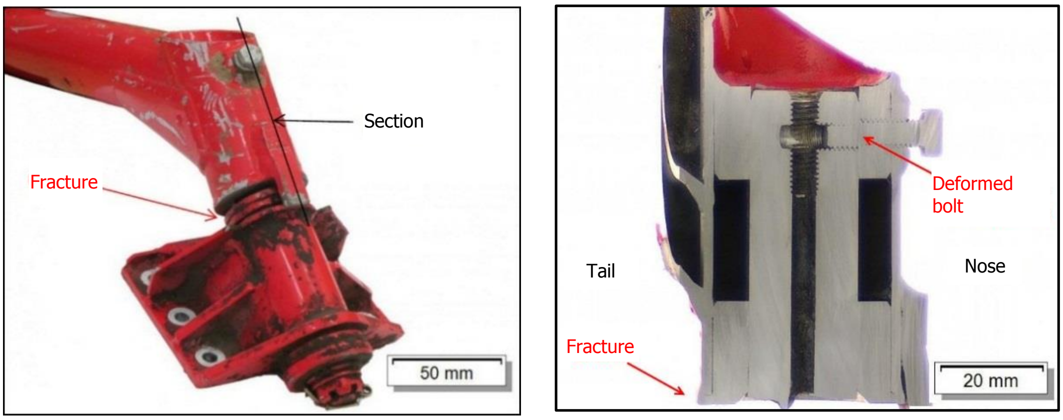

Figure 8: Displacement of the steering axle in the tube of the landing gear leg

The pronounced deformation of the steering axle flange on its aft side also indicates exertion of considerable force (cf. Figure 9).

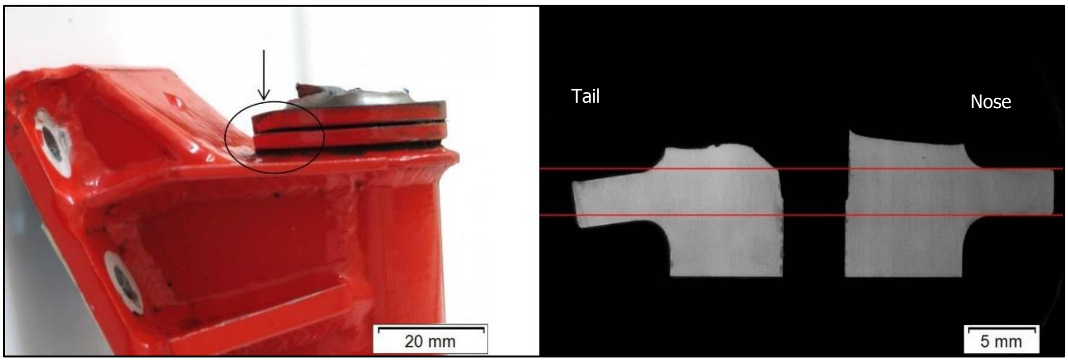

Figure 9: Deformation of the steering axle flange

The steering axle could no longer be rotated after the accident. This fact is explained in the investigation report as follows: "*Extensive plastic deformation of the flange occurred at the rupture. As a result of this deformation, the axle was no longer able to rotate after the rupture*." The possibility that the deformation of the steering axle flange (bending) was already present before the accident flight is explicitly excluded by the experts.

It was determined that the material of the steering axle was 34CrMo4 heat treated steel, which corresponded to the requirements of the aircraft manufacturer. The metallographic analyses indicate a heat treated grain structure in the core. Some areas of the material matrix, however, indicate a less than optimal heat treatment process.

1.7.3 Landing gear leg

The analysis of the surface of the landing gear leg fracture permits the conclusion that the fracture was due to fatigue crack formation perpendicular to the direction of travel. However, the proportion of these in the entire fracture surface was small. The remainder of the fracture indicates a ductile instantaneous fracture.

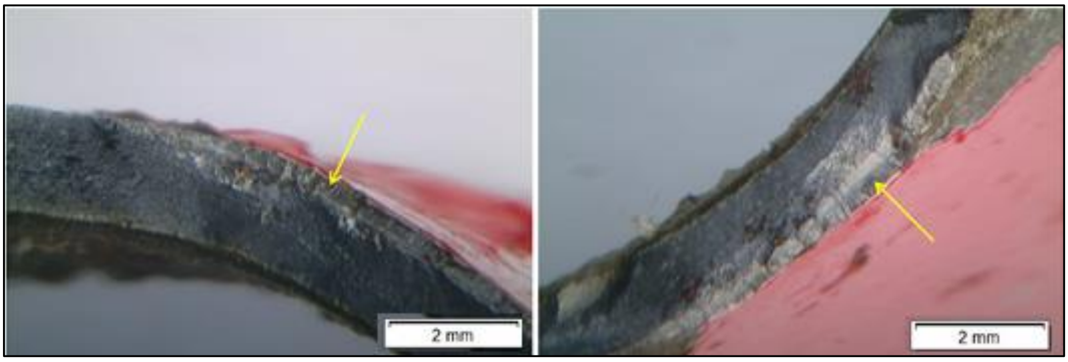

Figure 10: Surface of the landing gear leg fracture with fatigue cracks

The material of the landing gear leg was determined to be 34CrMo4 heat treated steel, which corresponded to the requirements of the aircraft manufacturer. There were no signs of material-related defects such as embrittlement. On the inner surface there were corrosive attacks in the form of pitting corrosion.

1.7.4 Nose wheel fairing attachment points

The fracture surfaces were very dirty and corroded. In the uncontaminated zones there is evidence of a fatigue crack formation. According to the expert's report, any connection between the fracture of the nose wheel fairing attachment points and the steering axle fracture is rather improbable.

1.8 Relevant procedural requirements

1.8.1 Information according to the pilots' handbook

The Sportcruiser's relevant speeds for take-off and landing are specified as follows in the manufacturer's pilot operating handbook (POH):

32 KIAS – Lift nose wheel

42 KIAS – Lift-off of aircraft

60 KIAS – Best angle of climb

65 KIAS – Best rate of climb

60 KIAS – Best glide angle

60 KIAS – Approach speed

39 KIAS – Stall speed with flaps at 0° position

32 KIAS – Stall speed with flaps at 30° position

Neither recommendations nor limitations exist with regard to the take-off and landing configuration of the aircraft. The procedure for setting the landing flap position for take-off and landing is *"extend as necessary".* The landing flap position can be set at any position between 0° and 30°.

The POH, in Section 7.9.2 on normal procedures states the following:

1. *Throttle - idle*
2. *Touch-down on main wheels*
3. *Apply brakes (after the nose wheel touch-down) - as necessary*

In the POH, no explicit distinction is made between normal and short field take-off and landing procedures.

For the landing distance, the POH gives the following information, without referring to the conditions associated with it:

	Landing distance over a 50 ft obstacle	Landing roll distance
Paved runway	181 m	55 m
Grass runway	171 m	61 m

Table 2: Information on landing distance from the POH

1.8.2 Comment by the manufacturer on final approach speed

In 2012, the aircraft manufacturer responded as follows to a request from the flying school regarding the final approach speed:

“Approach speed as defined in the POH (60 KIAS) is a safe speed to manoeuver the aircraft to the final approach in a traffic pattern. For final approach, a lower airspeed than 60 KIAS may be used as long as a reasonable margin over stall speed is maintained. Airspeed has to be reduced for landing in order to assure a touchdown on the main landing gears.”

On the basis of this statement a reduced final approach speed from the value in the POH was taught in the flying school (cf. Section 1.8.3).

As part of this investigation, the STSB inquired from the aircraft manufacturer how the approach airspeed of 60 KIAS had been determined and what airspeed at 50 ft was used as a basis for the landing distance information in the POH. Both questions remained unanswered in the response from the manufacturer.

1.8.3 Procedures of the flying school

The flying school operates the Sportcruiser according to its own checklist. This contains a pictorial summary of the standard procedures for a circuit of the aerodrome (cf. Figure 11).

It indicates an airspeed of 55 KIAS for the final approach with full flaps; this must not drop below 50 KIAS in the short final approach (gate).

The flight instructor recommended increasing these prescribed speeds by 5 knots for zero flap approaches.

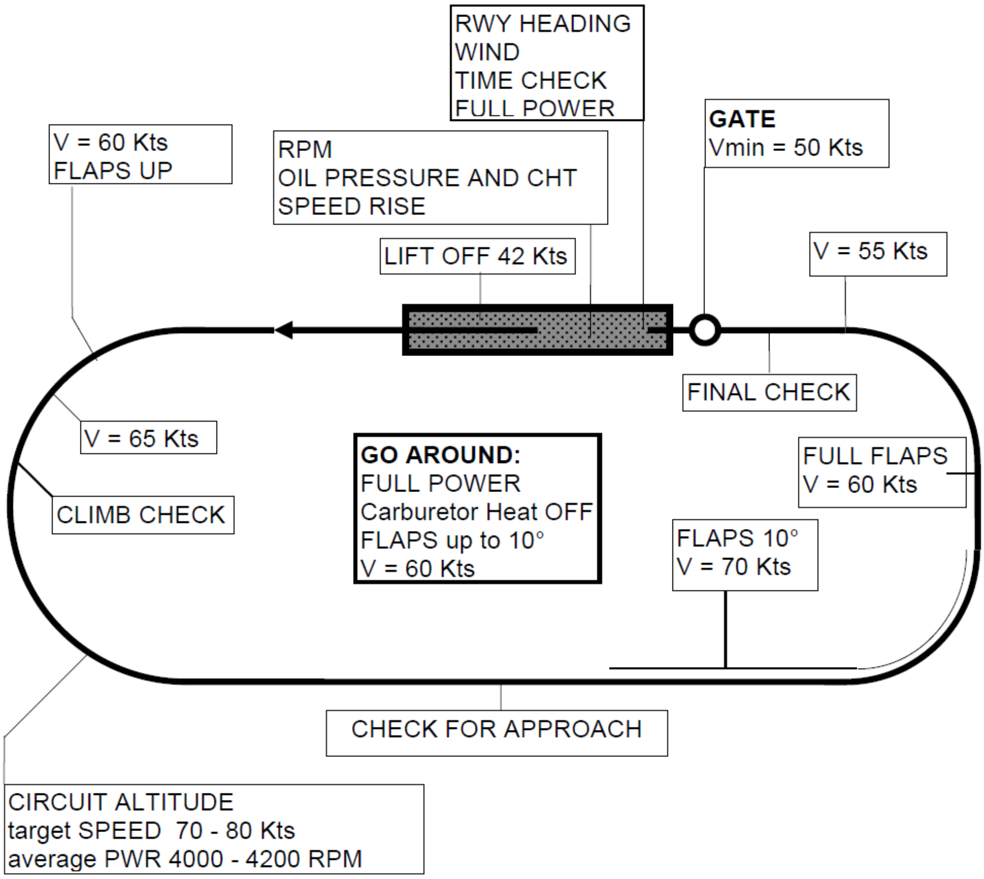

Figure 11: Standard procedures of the flying school for an aerodrome circuit (extract)

1.9 Additional information

1.9.1 Recordings of earlier flights

Recordings on the Flarm of earlier flights in May 2014 indicate that the majority of speeds at the gate were close to the flying school's standard value of at least 50 KIAS. In isolated cases, some on training and check flights, landing approaches were recorded at speeds which were markedly above the requirements in the POH and those of the flying school.

1.9.2 Information from another pilot

On 8 May 2014, a pilot who had considerable flying experience on the aircraft type in question happened to observe landings of HB-WYC at Speck-Fehraltorf airfield by the crew involved in the accident. He later stated: *"In my opinion the approach speed was so inappropriate for this aircraft type that I addressed the crew of HB-WYC about this problem on the spot after the landing. I recommended selecting a distinctly lower speed for the final approach* […]."

Referring to the manufacturer's requirements of the approach speed, this pilot summarised his experience of the aircraft type as follows: *"When applying the POH approach speed of 60 KIAS it is impossible to achieve a fully flared landing on a short runway. Without a fully flared landing, however, the nose wheel is inevitably overstressed, with the well-known consequences."*

1.9.3 Information from the flight instructor

When informed about the recorded approach speeds (cf. Section 1.5.3) and the technical investigation's results (cf. Section 1.7), the flight instructor stated that he could not recall a landing indicating an increased load on the nose gear wheel. If they had made a bounced landing[9], then he would have demanded a go-around or flown it himself. He was surprised by this data and had no explanation. Even after further clarifications and an examination of the records he was of the opinion that they essentially had the speeds on the approaches under control. There were approaches which were too fast, which he mentioned in the debriefing and which are also listed in the records. However, no approach resulted in a bounced landing.

1.9.4 Test flights at various final approach speeds

A series of approaches with different landing flap settings and approach speeds were flown at Lommis airfield with an aircraft of identical type.

This series of tests permits the conclusion that an airspeed of 60 KIAS at 50 ft above ground barely allows landings where the main gear's contact with the ground occurs both before that of the nose gear as well as within a normal landing distance of 150 m after the runway threshold. A flapless approach with an airspeed of approximately 67 KIAS at 50 ft above ground, as was the case in the accident flight, was aborted after flying past the half-way point of the runway. When complying with the flying school's standard procedure of at least 50 KIAS and the addition of 5 kt as recommended by the flight instructor for flapless landings, it was possible to achieve results which met the two above-mentioned criteria without difficulties.

1.9.5 Similar accidents

On 30 August 2014 the CSA Sportcruiser aircraft, registration G-EMSA and serial number 323, had a similar accident in England. The accident summary by the AAIB[10] read as follows:

“Following a normal approach and touchdown at a private grass airstrip, the nose landing gear failed. The nose wheel detached and the aircraft came to a rest within a short distance. Examination of the failed components showed what appeared to be a fatigue failure in the nose landing gear leg.”

A technical materials analysis such as the one performed in the present case was not carried out. However, the damage to the fractured steering axle corresponds to that on HB-WYC.

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[9] Landing during which the aircraft bounces back up in the air after the initial contact with the ground, often followed by a hard impact of the nose gear on the second or third contact with the ground.

[10] AAIB: Air Accidents Investigation Branch (UK)

Figure 12: Fractured steering axle of G-EMSA (AAIB Bulletin 11/2014)

On 4 May 2015 in Germany, the steering axle of a CSA Sportcruiser aircraft, registration D-EGPZ and serial number 290, fractured after a touch-and-go. The subsequent landing of the aircraft without a nose wheel was made on a concrete runway with the engine shut down, without the nose gear leg fracturing.

Figure 13: Fractured steering axle of D-EGPZ

On 20 August 2015 in Germany, the nose wheel of a CSA PS-28 Cruiser, registration D-EMNA and serial number 459, broke loose shortly after the aircraft took off for a training session in the aerodrome traffic circuit. The instructions specified in the *emergency airworthiness directive* (EAD) 2015-0109-E of EASA (cf. chapter 4.3) seem to have been carried out without findings by a local maintenance shop.

Figure 14: Fractured steering axle of D-EMNA

2 Analysis

2.1 Technical aspects

Fatigue cracks which had formed over a long duration were found on the nose gear steering axle. This resulted in a significant, pre-existing weakening of the steering axle.

In the course of the landing the remaining area not affected by the cracking was overloaded and this caused the steering axle to fracture. As a result of the rotation of the lower part of the landing gear which was breaking off, a high tensile load was imposed on the steering axle, and this caused major deformation of the retention bolt. The nose gear leg, also weakened by fatigue cracking, contacted the runway, broke off to the rear and pierced the floor of the fuselage.

Because of the pre-existing and continuously propagating fatigue cracking, the steering axle fracture occurred randomly.

The design of the nose gear was subject to a known weakness, which caused the manufacturer to publish the initial issue of service bulletin SB-CR-016 prescribing regular inspections of the landing gear leg. The area required to be checked for cracking as part of this inspection was located outside the damage locations of the present case. The fatigue cracks could not be detected by visual inspection.

A pre-existing deformation of the steering axle, as described in the revised versions of the service bulletin (cf. Figure 15), cannot be completely excluded in the present case, because the corresponding examination of the steering axle was not yet included in the version of the service bulletin available at the time of the accident.

The multiple revisions of the service bulletin after the accident (cf. Section 4.3), the failure of the nose gear after only approximately 400 hours of operation and 1134 landings, and similar cases in England and Germany raise fundamental questions about the design of the nose gear as found. This is corroborated by service bulletin SB-CR-021 published on 10 July 2014, in which the aircraft manufacturer recommends the fitting of a modified nose gear, as well as the *emergency airworthiness directive* (EAD) 2015-0109-E of EASA published on 12 June 2015 (cf. Section 4.3).

2.2 Human and operational aspects

The formation of fatigue cracking on the nose gear is attributable to reverse bending stresses, such as occur during take-off and landing rolls. These stresses depend on the condition of the ground, the weight on the nose wheel and the rolling speed. The pilot exercises a great influence on the latter two variables via the elevator control; to reduce the stress on the nose wheel, it must be lifted from the ground on take-off as early as 32 KIAS, in accordance with the pilot operating handbook (POH); on landing, it must be lowered to the ground only after the main landing gear has touched down.

Touching-down the aircraft on the nose gear, as occurs at high final approach speeds, is to be avoided, which is why the aircraft manufacturer highlights this in his reply to corresponding request of the flying school: "*Airspeed has to be reduced for landing in order to assure a touch-down on the main landing gears.*"

The manufacturer's standard procedures do not include any reference to final approach speeds. The absence of values that should be complied with in order to achieve the landing distances indicated in the POH must be especially criticised; these include in particular the airspeed at 50 ft. The introduction of the flying school's procedure (cf. Section 1.8.3) constituted an appropriate clarification of the manufacturer's standard procedures and was effective to minimise stress on the nose gear.

The recordings of earlier flights demonstrate that though the flying school's procedure was known and for the most part complied with, there were still isolated cases in which landings at an excessively high speed did occur. These recordings indicate that HB-WYC was operated with excessive tolerances in terms of approach speed and as a result in terms of the pitch attitude on landing. During training flights, the flight instructors' intervention behaviour with regard to the *"touch-down on the main landing gears"* criterion was not always commensurate with the lightweight construction of the nose gear. This was also the case in the accident flight, in which the aircraft was still touched-down within a normal landing distance of 150 m after the runway threshold despite an airspeed of approximately 67 KIAS at 50 ft.

The resolution of the EFIS data recorded at five seconds intervals does not permit a detailed reconstruction of the landing. However, given the pre-existing damage, the stress on the nose gear during landing exceeded the load bearing capacity, causing the steering axle to deform and finally fracture. Unevenness in the grass runway may have contributed to this stress on the nose gear. The formation of fatigue cracks was aggravated by operation on grass runways, which service bulletin SB-CR-021 (cf. Section 4.3) also indirectly refers to.

3 Conclusions

3.1 Findings

3.1.1 Technical aspects

- The aircraft was licensed for VFR operations.
- The aircraft's mass and centre of gravity were within the permissible limits throughout the flight.
- The design of the nose gear was subject to a known weakness, which caused the manufacturer to publish the initial issue of service bulletin SB-CR-016.
- The aircraft's maintenance was carried out in accordance with the prescribed requirements.
- The material of the steering axle and the landing gear leg corresponded to the aircraft manufacturer's specifications.
- Fatigue cracks had formed on the steering axle of the nose gear which could not be detected during the maintenance activities.

3.1.2 Crew

- The crew was in possession of the necessary licenses for the flight.
- There are no indications of the crew suffering any health problems during the accident flight.

3.1.3 History of the flight

- At 11:37 the Sportcruiser HB-WYC took off from runway 24 at Lommis airfield (LSZT) on a single circuit of the aerodrome.
- The final approach was made without the assistance of the landing flaps. At 50 ft above ground an airspeed of approximately 67 KIAS was indicated.
- In the course of the landing the nose gear failed, causing the aircraft's nose to impact the runway.
- The crew were uninjured. The aircraft was slightly damaged.

3.1.4 Operational aspects

- The pilot operating handbook *(*POH) specifies an approach speed of 60 KIAS regardless of the landing configuration.
- The POH does not contain any information on the final approach speed.
- According to the manufacturer, the airspeed should be reduced so that initial contact with the ground is made by the main gear.
- The flying school recommended a minimum final approach speed of 50 KIAS with full flaps.

3.1.5 General conditions

- The weather had no influence on the occurrence of the accident.

3.2 Causes

The accident is attributable to a fracture of the previously damaged nose gear steering axle during the landing.

The following factors contributed to the pre-existing damage:

- inappropriate design of the nose gear;
- approaches at an excessive speed;
- frequent operation on grass runways.

4 Safety recommendations, safety advices and measures taken since the accident

4.1 Safety recommendations

None

4.2 Safety advices

None

4.3 Measures taken since the accident

The manufacturer's service bulletin SB-CR-016 was published on 26 June 2014 in a revised version (Rev. 1). In addition to the existing inspection of the nose gear leg for cracks, an inspection of the front steering axle for bending was prescribed (cf. Figure 15).

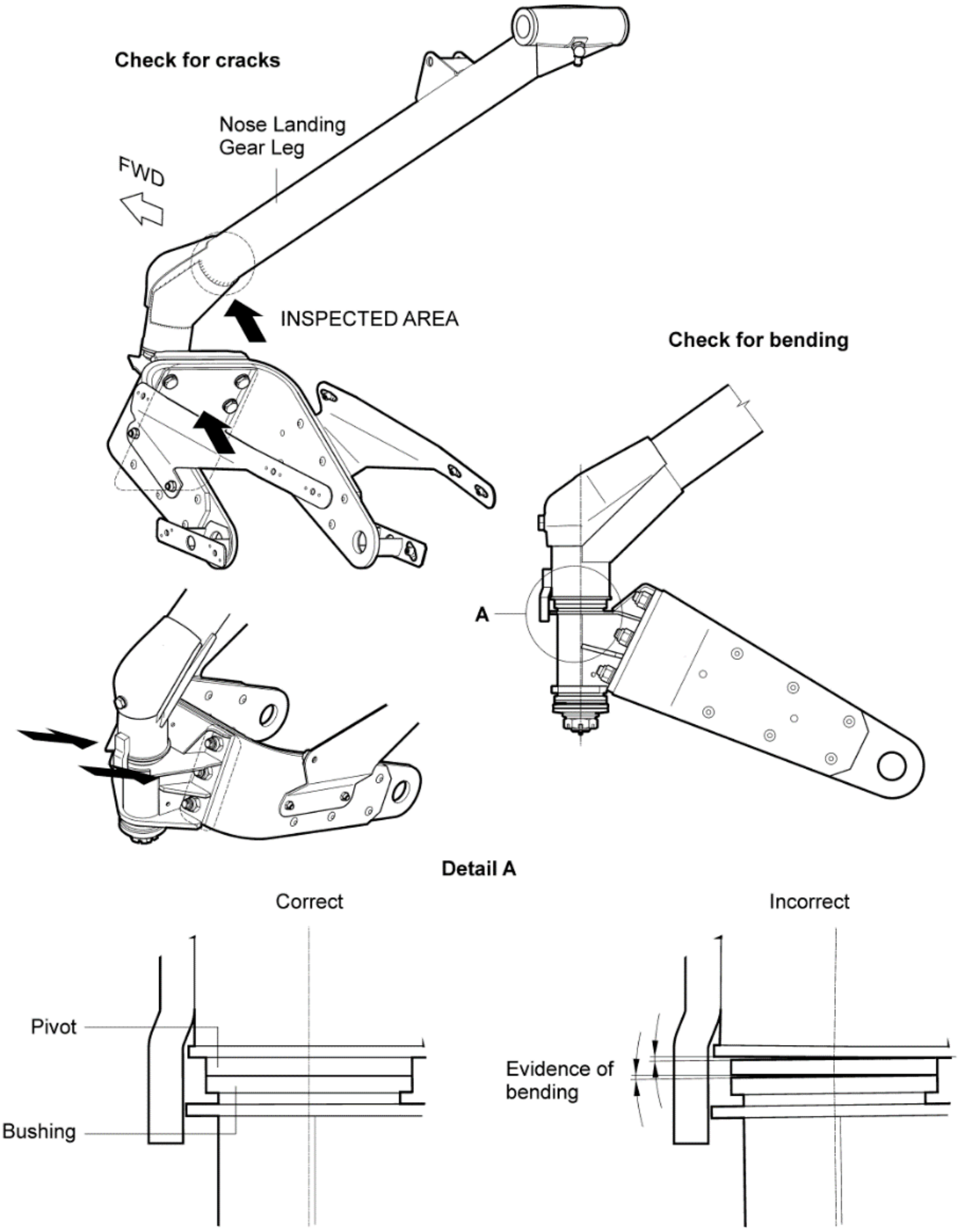

Figure 15: Extended examination of the nose landing gear according to SB-CR-016 Rev.6

The latest version of this publication is dated 31 August 2015 (Rev. 6) and states:

"Some SportCruiser / PiperSport / PS-28 Cruiser aircraft have developed cracks in the bottom side of the lower section of the nose landing gear (NLG). The cracks develop on the NLG assembly along the weld of the tube and the bracket. Furthermore, on several aircraft bending of the pivot connecting the fork with leg was discovered and cracks from holes of bolts on the fork. To address this potentially unsafe condition, a repetitive inspection is required of the bottom side of the lower section, in the area of the weld of the tube, the bracket and the pivot and the fork in the place of the bolts mounting the fork to the landing gear."

On 10 July 2014 the aircraft manufacturer published an additional service bulletin SB-CR-021. It recommends replacement with a re-designed nose gear instead of the inspection of the nose gear prescribed in accordance with SB-CR-016:

"Some PS-28 Cruiser / SportCruiser / PiperSport aircraft have developed cracks in the bottom side of the lower section of the nose landing gear (NLG) SG0270N. To address this potential condition, CSA has issued service bulletin SB-CR-016 that prescribes an inspection of the nose landing gear SG0270N. Subsequently, CSA have developed an improved NLG SG0300N, which has better fatigue-resistant properties. For the reasons described above, CSA recommends replacement of the NLG SG0270N with an improved NLG SG0300N especially on aircraft used in intensive flight training activity and operated from unpaved runways."

On 12 June 2015 EASA published the *emergency airworthiness directive* (EAD) 2015-0109-E, which has been superseded by EAD 2015-0185-E on 1 September 2015. The reason for these publications is given as follows:

"Cracks were found on the bottom side of the lower section of the nose landing gear (NLG). The subsequent investigation revealed that the cracking developed along the weld of the tube and the bracket of the NLG assembly. Additionally, bending was identified, involving a connecting pivot of the fork with the leg. In some cases, growth of cracks was detected originating from holes of the fork bolts.

This condition, if not detected and corrected, could lead to loss of the NLG structural integrity, possibly resulting in NLG collapse and consequent damage to the aeroplane and injury to occupants.

To address this potential unsafe condition, Czech Sport Aircraft a.s. issued Service Bulletin (SB) SB-CR-016 Revision 5 to provide repetitive inspection and replacement instructions and developed an improved NLG, Part Number (P/N) SG0300N, incorporating features making the design more crack-resistant.

Consequently, EASA issued AD 2015-0109-E to repetitive inspections of the NLG P/N SG0270N and, depending on findings, replacement with a new part P/N SG0270N or with an improved part P/N SG0300N.

Since that AD was issued, a new occurrence was reported involving in flight detachment of NLG P/N SG0270N, which showed that the required inspection might not prevent a loss of the NLG structural integrity. Prompted by this development, Czech Sport Aircraft a.s. issued SB-CR-016 Revision 6, referencing SB-CR-021 which provides instructions to replace the NLG with an improved NLG P/N SG0300N."

Payerne, 15 December 2015 Investigation Bureau STSB

This final report was approved by the Board of the Swiss Transportation Safety Investigation Board STSB (Art. 10 lit. h of the Ordinance on the Safety Investigation of Transportation Incidents of 17 December 2014).

Berne, 10 December 2015