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Swiss Transportation Safety Investigation Board STSB

Interim report by the Swiss Transportation Safety Investigation Board STSB

concerning the accident involving the motorglider SF 25C "Falke", D-KDEU,

on 17 October 2021

Airfield Dierdorf (EDRW),
Germany

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General information on this report

This interim report from the Swiss Transportation Safety Investigation Board (STSB) was prepared further to article 44 of the Ordinance of 17 December 2014 on the Safety Investigation of Transport Incidents (OSITI), version as at 1 February 2015 (SR *742.161*).

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 Act on Civil Aviation (AviA; SR 748.0) of 21 December 1948 (version as at 1 August 2021), the sole purpose of an investigation into an aircraft accident or serious incident is to prevent further such accidents and incidents. The legal assessment of the circumstances and causes of aircraft accidents and serious incidents is expressly excluded from the scope of the aircraft accident investigation. It is therefore not the purpose of this report to determine blame or to determine liability.

Should this report be used for purposes other than those of accident prevention, this statement must be given due consideration.

For reasons of prejudice, the German Federal Bureau of Aircraft Accident Investigation (BFU) delegated the investigation to the Swiss Transportation Safety Investigation Board (STSB), which is publishing this interim report.

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

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), valid for the territory of Germany, which corresponded to Central European Time (CET) at the time of the accident. The relation between LT, CET and Cordinated Universal Time (UTC) is:
LT = CET = UTC + 2 hour.

Synopsis

Aircraft	SF 25C “Falke”				D-KDEU
Operator	Luftsportverein Neuwied e.V., Flugplatz, 56269 Dierdorf, Germany				
Owner	Luftsportverein Neuwied e.V., Flugplatz, 56269 Dierdorf, Germany				
Flight instructor	German citicen, born 1958				
Licence	Private Pilot License Airplane (PPL(A)) in compliance with the standards of the European Union Aviation Safety Agency (EASA), issued by the Landesbetrieb Mobilität Rheinland-Pfalz, Germany, with class rating for Touring Motor Glider (TMG) and Flight Instructor (FI) rating.				
Flying experience	**total**	5764 h	**during the last 90 days**	30 h	
	on type	717 h	**during the last 90 days**	5 h	
Flight student	German citicen, born 1969				
Licence	None (in training)				
Flying experience	**total**	3 h	**during the last 90 days**	3 h	
	on type	3 h	**during the last 90 days**	3 h	
Location	Airfield Dierdorf (EDRW), Germany				
Coordinates	---		**altitude**	---	
Date and time	17 October 2021, 13:22 hrs				
Type of operation	Instruction				
Flight rules	Visual Flight Rules (VFR)				
Point of departure	Airport Dierdorf (EDRW), Germany				
Destination	Airport Dierdorf (EDRW), Germany				
Flight phase	Take-off and climb				
Type of accident	Loss of control				

Injuries to persons

Injuries	Crew	Passengers	Total of occupants	Third persons
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	2	0	2	Not applicable
Total	2	0	2	0

Damage to aircraft	Severly damaged
Other damage	Minor land damage

1 Factual information

1.1 Flight preparations and history of flight

1.1.1 General

The description of the event is based on the information provided by the flight crew and eyewitnesses, as well as the traces of the takeoff run. The flight was a training flight under Visual Flight Rules (VFR).

1.1.2 Pre-flight history

The student pilot was in training to obtain the Light Aircraft Pilot Licence (LAPL(A)) with the class rating for Touring Motor Glider (TMG). She planned to conduct her fourth training flight with the instructor on 17 October 2021.

Considering the student pilot's low level of experience, the pre-flight check was conducted in detail. During the rudder test, counterpressure was applied to the control stick with the control surfaces held tight, as is common in gliders. It was no longer possible to determine whether the left or right control stick was used for this purpose. While explaining the function of the elevator trim, the instructor set it to a position that tended to be nose down. He noted that this was better for takeoff than a nose up position; the trimmed position could subsequently be determined and adjusted in flight.

The crew then started the engine of the motorglider and taxied to the taxiway holding point of runway 25 in Dierdorf. There, the flight instructor performed the "before takeoff" checklist, which included the engine run-up and a functional check of all control surfaces. Shortly thereafter, the crew taxied the motorglider to the runway end (backtrack). During this phase, the student pilot held the control stick while the instructor operated the throttle and the wheel brake by means of the airbrake lever and the rudder pedals. At the runway end, he turned the motorglider and aligned it with the runway axis. While turning on the uneven, bumpy grass surface at this position, the motorglider had shaken quite a bit.

1.1.3 History of flight

On 17 October 2021, at 1:22 pm, the student pilot, seated in the left pilot's seat, and the flight instructor, seated to her right, took off in the SF 25C "Falke" motorglider, registered as D-KDEU, from runway 25 of airport Dierdorf (EDRW). The flight instructor operated all controls[1] and commented his rudder inputs, the student pilot felt at the control stick and the rudder pedals.

According to the flight instructor, the take-off run took place in calm conditions and was normal up to the height of the airfield buildings. After approximately 245 m, the motorglider veered to the right onto the grass strip adjacent to the hard-surface runway (see Figure 1, position ❶). At this moment, the airplane did not react immediately to the control inputs. The instructor suspected that the student pilot was locking the control stick or the rudder pedals, so he told her to release them. The student pilot stated that she was not holding any of the controls and heard the instructor yell *"aileron, aileron"* at that moment. The motorglider subsequently took off after a take-off run of approximately 335 m (position ❷) and picked up speed flying close to the ground, which the instructor perceived as normal and controlled by him. The airplane flew in a direction that deviated about 30° to the right from the runway axis and in which the terrain was slightly sloping.

[1] The primary control surfaces are the control stick and the rudder pedals. The pilot's inputs to these controls are transmitted to the primary control surfaces, i.e. aileron, elevator and rudder, via a control linkage or control cables.

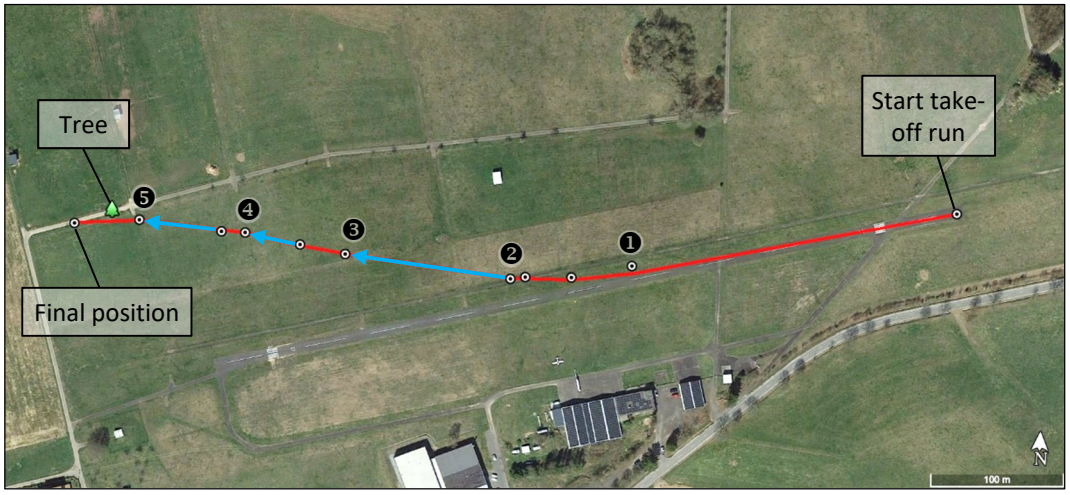

Figure 1: Takeoff of D-KDEU (red line), determined based on the traces of the takeoff run in the grassland (small white circles), shown in google earth. The blue arrows indicate the phases in which the motorglider was in the air.

Eyewitnesses who observed the take-off run saw the motorglider moving on the runway with a "lowered nose", i.e. with an unusual negative pitch attitude at this stage, before it veered to the right and took off. In flight, the aircraft had maintained this negative pitch attitude.

About 125 m after lift-off (position ❸), the motorglider touched down with its undercarriage in the grassland for the first time and unexpectedly for the flight crew, and took off again shortly afterwards. Until that moment, the instructor was convinced that the motorglider would fly normally and only needed to pick up some speed. The terrain in the direction of flight was sloping and therefore enabled a problem-free continuation of the flight. An aborted take-off, on the other hand, would have inevitably led to a collision with the trees ahead. For this reason, he immediately dismissed the idea of aborting the take-off.

After the motorglider was airborne again, the nose of the aircraft dropped anew and the landing gear of the motorglider touched the grassland a second time (position ❹). At the same time, the aircraft headed for a tree next to a dirt road ahead (see Figure 1). At this stage, the instructor realised that something was wrong and that he had lost control of the motorglider. He had tried to avoid the tree in front with full control deflections.

As a result, the motorglider hit the grassland again (position ❺), this time very violently. The propeller tips touched the ground and broke off. The right wing subsequently collided with the tree, seperating the right outer wing. The motorglider then turned 180° around its vertical axis to the right and, skidding on the main landing gear, came to rest on the dirt road (see Figure 2). During this manoeuvre, the left outer wing was separated and the aircraft suffered severe damage to the tail unit and fuselage.

The crew remained uninjured. No fire broke out.

Figure 2: Final position of the D-KDEU seen in the direction of flight. On the right the tree, with which the right wing collided (blue arrow), and in the center the track of the main wheel in the meadowland (yellow arrow).

1.2 Aircraft information

1.2.1 General

Registration mark	D-KDEU
Aircraft model	SF 25C «Falke»
Characteristics	Two-seater, mid-wing motorglider, of mixed construction and equipped with single-wheel main landing gear with tailwheel and support wheels under the wings.
Manufacturer	Scheibe-Flugzeugbau GmbH
Year of manufacture	1977
Serial number	44 194
Engine	Sauer S2100-1-AS1, air-cooled four-cylinder boxer engine, serial number 133, maximum power at 3000 RPM[2], maximum continuous power 49 kW (67 hp) at 2500 RPM.
Propeller	MT-Propeller MT 150L 102-1A, 2-blade fixed pitch propeller, made of laminated hardwood.
Operating hours	Airframe 8266:06 hrs (TSN[3]), 20 660 landings
	Engine 1709:19 hrs (TSN)
Max. permissible take-off mass	610 kg

[2] RPM: revolutions per minute

[3] TSN: time since new

Mass and centre of gravity	An estimate showed that the mass of the aircraft at the time of the accident was around 610 kg. The centre of gravity was within the permissible limits according to the flight manual.
Maintenance	The most recent maintenance work was conducted on 21 August 2021 at 8225:40 hrs.

1.2.2 Controls and control linkage

The motorglider SF 25C "Falke" is equipped for each crew member with a control stick, rudder pedals and an airbrake lever, which also operates the wheel brake. The engine is operated centrally via a power lever and a lever for carburettor preheating and choke.

The control sticks are located centrally in front of the two seats and are made of steel tubes welded together. Each control stick is freely movable and connected to the fuselage steel tube construction via a fixed bearing (see Figure 3, red dotted circles). At the lower end of the control sticks are the transfer joints (blue-dashed circles), which are connected to each other via the connecting tube. The intermediate lever, which is mounted freely on the connecting tube, and the front rocker move the torque tube, which controls the ailerons and elevators.

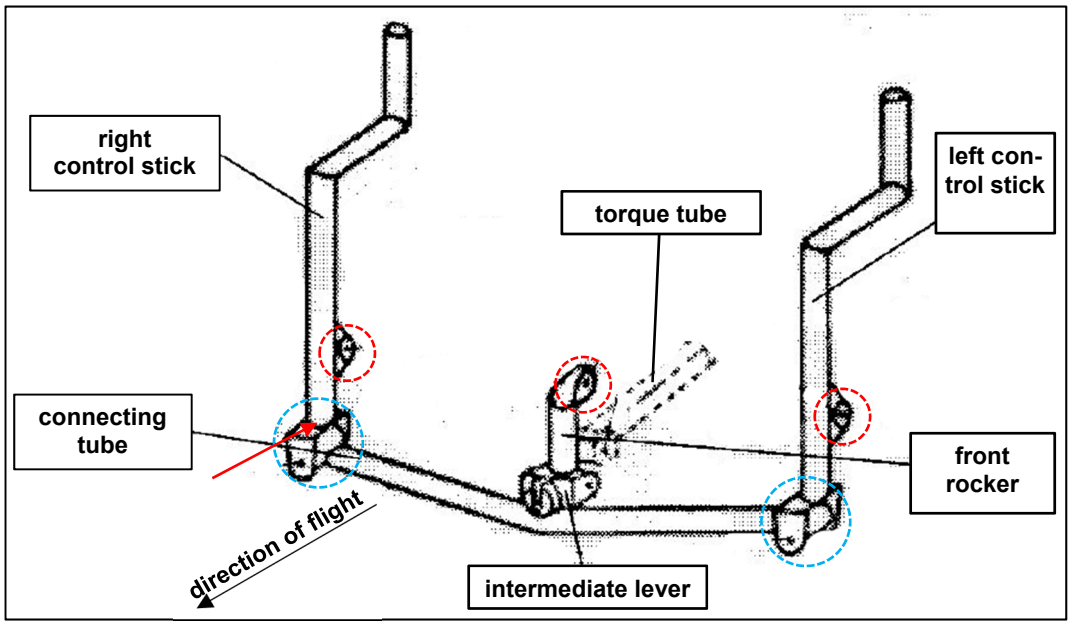

Figure 3: Schematic of the control parts for aileron and elevator control with the fixed bearings (red dashed circles) and the transfer joints (blue dashed circles). The red arrow indicates the postition where the right control stick of D-KDEU was broken. Source of graphic: Aircraft manufacturer, processed by SUST.

According to the manufacturer's drawing, the steel tubes of the controls of D-KDEU were made from structural steel St 35 [4]. This steel can be welded and formed well, but has low corrosion resistance without surface protection. To increase the corrosion resistance of this steel, measures are required such as coating processes.

According to the drawing, the steel tubes of the controls had a diameter of 26 mm and a wall thickness of 1 mm.

[4] The former steel designation St 35 can now be compared with a steel of the type E235 (1.0308).

1.2.3 Maintenance and airworthiness

For the maintenance of the motorglider SF 25C, a "maintenance list for the airframe" exists, which was used and completed during the last maintenance work on D-KDEU on 21 August 2021. This maintenance list does not contain instructions for a detailed inspection of the controls and control linkage with regard to cracking or corrosion or the integrity of the anti-corrosion coating.

In addition, there is an "Inspection programme for older aircraft, older than 12 years (25 years)", which was carried out annually by the aviation authority inspector on D-KDEU in addition to the inspection programme of the annual inspection and was last signed in August 2021. In this inspection programme, the inspection points for the control system also do not contain detailed information on the extent of the respective inspection.

1.3 Technical findings

The examination of the motorglider revealed the following findings concerning the control organs and the control linkage (see Figures 4 to 7):

- The right control stick was broken above the weld seam at the transfer joint.
- The fracture was visibly corroded on both sides.
- Inside the broken steel tube (inner surface of the tube) of the control stick there was heavy corrosion.

Figure 4: Overview of the controls for aileron and elevator with the broken right control stick (left side on the picture, see also red arrow in Figure 3).

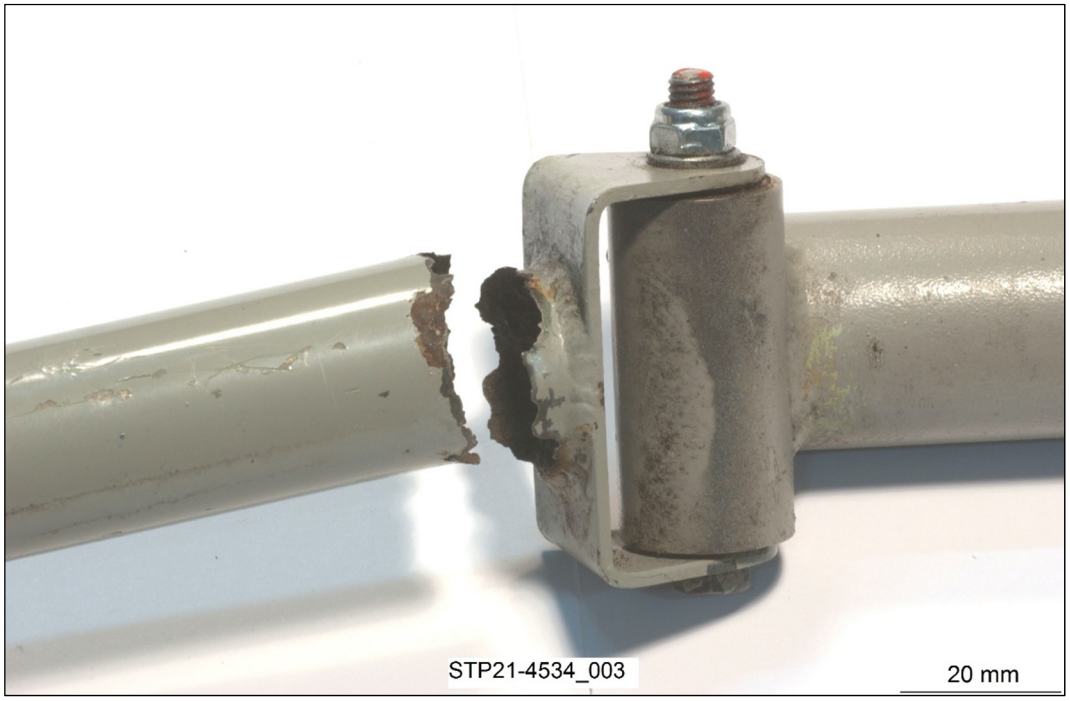

Figure 5: Fracture of the steel tube of the right control stick above the weld seam at the transfer joint.

Figure 6: Fracture point at the transfer joint, near the weld seam / heat-affected zone.

Figure 7: Fracture of the steel tube of the right control stick with heavily corroded inner surface of the tube.

The affected controls and control linkage will be further investigated metallographically. The corresponding details will be included in the final report.

1.4 Aircraft ageing

1.4.1 Motorglider SF 25 «Falke»

The motorglider SF 25 "Falke" has been in production since 1963 until today. The fuselage consists of a tubular steel frame covered with cloth, the wings are of plywood construction and are also covered with cloth. The controls and the control linkage are made of tubular steel tubes.

To date, the manufacturer of the SF 25 "Falke" motorglider has not published any Safety Bulletins that would address the ageing phenomena on the controls or the control linkage of the aircraft that occurred in the present accident.

1.4.2 Ohter sailplane types

Various other gliders of mixed construction with similar design features as the SF 25 “Falke” motorglider were produced between the 1950s and 1970s. Examples of this are the K 7, K 8, ASK 13, ASK 16 and ASK 18 built in large numbers by the manufacturer Alexander Schleicher in Germany.

A Safety Bulletin was published on 12 July 2021 for each of the above-mentioned types of glider manufactured by Schleicher, describing the following safety deficiency:

"It has been noted that there are an increasing number of reports of incidents involving structural failure due to material fatigue or other signs of ageing [...]. *While in Germany for national aircraft (Annex I) the NfL II 6/12 currently establishes regulations for the maintenance and inspection of older aircraft, an equivalent regulation at the European level is only in the process of being developed. Also, the operating manuals of the aircraft concerned do not contain any specifications for maintenance in the case of long operating times and aircraft age ("service life test*

programmes"). The aim is to achieve a uniform European solution for older aircraft."

In the case of the type K 8, the Safety Bulletin No. 24 was published on 7 December 1995, containing the following details:

"As a result of moisture ingress, rust damage may occur to the inner walls of the fuselage frame tubes and control rods.

[...]

Check elevator pushrods [...] for bending, deformation or damage. If bending, deformation or damage is found, the pushrod must be replaced with a new one."

In the Safety Bulletin No. 26 of the type ASK 21 dated 24 August 1993, the manufacturer Schleicher states:

"In some glider models of other manufacturers, elevator pushrods were found to show partially severe corrosion under particularly unfavourable conditions.

[...]

Measures: Dismantle rudder and elevator pushrod. [...] *Drill a 6 mm diameter hole in the U-profile of the end of the pushrod according to the drawing [...]. Inspect the inside of the bumper for corrosion (visual inspection through the drilled hole with a suitable instrument, such as an endoscope* [...]*".*

1.4.3 Maintenance and inspection of older aircraft

In an announcement on the maintenance and inspection of older aircraft published by the Deutsche Flugsicherung (German Air Traffic Control) on behalf of the Luftfahrt-Bundesamt (German Federal Aviation Authority) on 12 January 2012 [5], the increased ageing phenomena of older aircraft in particular, irrespective of their design, are addressed. These occur as a function of environmental influences, operating conditions and the general state of maintenance and relate in particular to corrosion, rotting, embrittlement, fatigue and wear.

In the absence of an adequate inspection and testing programme by the manufacturer for condition monitoring during ageing of the aircraft, special consideration shall be given to this circumstance during the annual inspection. Aircraft of wood or wood-mixed construction are considered older aircraft if they are more than 12 years old, or aircraft of metal or fibre-reinforced plastic construction if they are more than 25 years old.

With regard to the controls and control linkage, at least the control pushrods and their bearing blocks as well as suspension points and all control cables and pulleys should be inspected and checked in particular. Besides this, the document does not contain detailed information on the procedure for such an inspection, such as checking for cracks or corrosion or the integrity of the corrosion protection.

[5] The announcement is included in the "Nachrichten für Luftfahrer" (NfL), 60th year, NfL II 6/12.

2 Analysis

2.1 Technical aspects

2.1.1 Controls and control linkage

The right control stick of the motorglider D-KDEU was broken directly above the weld seam of the transfer joint (see Figure 3) and was therefore only attached to the fixed bearing. This meant that the flight instructor, who was sitting in the right-hand seat, could still move the control stick but could no longer make any control inputs for aileron and elevator. The aileron could still be moved with the left control stick, which the student pilot was feeling for during the take-off run. However, due to the construction of the control linkage, the elevator could no longer be controlled with this stick.

According to the manufacturer's drawing, the controls and control linkage were made of the structural steel St 35 (today E235), which is easily weldable and formable. The disadvantage of this steel is its low corrosion resistance. A surface protection on the inside as well as on the outside of the steel tube is therefore necessary.

The steel tube of the right control stick was heavily corroded on the inside, which apparently led to a weakening of the tube The rupture of the tube occurred in this heavily corroded area. The affected controls and control linkage will be further investigated metallographically. The corresponding details will be included in the final report.

In the "Maintenance list for airframe" and the "Inspection programme for older aircraft, older than 12 years (25 years)", which were used on D-KDEU for maintenance work and inspection, there are no instructions for a detailed inspection of the controls and control linkage with regard to formation of cracks or corrosion or the integrity of the corrosion protection. Since the ends of the broken steel tube of the right control linkage were welded shut, the inside of the tube could not be inspected for corrosion. It is therefore obvious that the corrosion inside the steel tube had not been noticed during any of the maintenance work.

The inspection and testing of such a steel tube requires a clearly defined inspection method, such as crack testing or inspection by means of a borescope. However, since the maintenance instructions available for all SF 25 types do not contain such detailed procedures, it can be assumed that similar corrosion phenomena exist on other SF 25 aircraft. For this reason, the STSB issues a corresponding safety recommendation (see Chapter 4.1.1).

2.1.2 Ageing of older aircraft

Other types of glider of comparable design and with a similar production period also showed structural failure due to material fatigue or other signs of ageing. From this, it can be concluded that the ageing phenomena are not limited to a single aircraft type or component and occur particularly in older aircraft. More detailed clarifications in this regard are underway and further information will be included in the final report.

2.2 Human and operational aspects

Further information will be given in the final report.

3 Conclusions

3.1 Findings

Further information will be given in the final report.

3.2 Causes

> In order to achieve its objective of prevention, a safety investigation authority shall express its opinion on risks and hazards that have been identified during the investigated incident and which should be avoided in the future. In this sense, the terms and formulations used below are to be understood exclusively from the perspective of prevention. The identification of causes and contributory factors does not, therefore, in any way imply assignment of blame or the determination of administrative, civil or criminal liability.

Further information will be given in the final report.

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

4.1 Safety recommendations

In accordance with international[6] and national[7] legal bases, all safety recommendations are addressed to the supervisory authority of the competent state. In Switzerland, this is the Federal Office of Civil Aviation (FOCA) or the supranational European Union Aviation Safety Agency (EASA). The competent supervisory authority must decide on the extent to which these recommendations are to be implemented. Nonetheless, any agency, organisation and individual is invited to strive to improve aviation safety in the spirit of the safety recommendations expressed.

The STSB shall publish the answers of the relevant federal office or foreign supervisory authorities at http://www.sust.admin.ch to provide an overview of the current implementation status of the relevant safety recommendation.

4.1.1 Controls and control linkage of the motorglider SF 25 “Falke”

4.1.1.1 Safety deficit

In a motorglider of the type SF 25C, the right control stick broke directly above the weld seam of the transfer joint, so that control inputs to aileron and elevator were no longer possible with this stick. Due to the design, the aileron could still be controlled with the left stick, but not the elevator. The flight crew, for whom the rupture of the control stick remained undetected, therefore lost control of the motorglider during the take-off run. The aircraft hit the ground hard, collided with a tree and came to a halt severely damaged.

The investigation revealed that the broken steel tube was heavily corroded on the inside and therefore weakened. According to the manufacturer's drawing, the material used was the structural steel St 35 (nowadays E235), which has low corrosion resistance. There were no manufacturer's instructions that provided for a periodic check on the formation of cracks or corrosion or on the integrity of the anti-corrosion coating of these controls.

4.1.1.2 Safety Recommendation No. 581

The European Union Aviation Safety Agency (EASA), in cooperation with the aircraft manufacturer Scheibe Aircraft GmbH, should take measures to ensure that motorgliders of the type SF 25 are only operated if no such corrosion phenomena exist on their controls and control linkages.

[6] Annex 13 of the International Civil Aviation Organization (ICAO) and article 17 of 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 and repealing Directive 94/56/EC.

[7] Article 48 of the Swiss Ordinance on the Safety Investigation of Transport Incidents (OSITI) of 17 December 2014, as at 1 February 2015 (OSITI, SR 742.161).

4.2 Safety advice

The STSB may publish general relevant information in the form of safety advice[8] if a safety recommendation in accordance with Regulation (EU) No. 996/2010 does not appear to be appropriate, is not formally possible, or if the less prescriptive form of safety advice is likely to have a greater effect.

None

4.3 Measures taken since the accident

The measures taken, of which the STSB is aware, are mentioned below without further comment.

None

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.

Bern, 21 December 2021 Swiss Transportation Safety Investigation Board

[8] Article 56 of the Swiss Ordinance on the Safety Investigation of Transport Incidents (OSITI) of 17 December 2014, as at 1 February 2015 (OSITI, SR 742.161)