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Commission fédérale sur les accidents d'aviation
Commissione federale sugli infortuni aeronautici
Federal Aircraft Accident Board

Final Report No. 1963
by the
Federal Aircraft Accident Board

concerning the accident

to the Enstrom 480 helicopter, registration HB-XJQ

on 19 March 2003

Chilenfeld, municipality of Geltwil/AG

30 km north of Lucerne

This final report has been prepared of the Federal Aircraft Accident Board according to art. 22 – 24 of the Ordinance relating to the Investigation of Aircraft Accidents and Serious Incidents (VFU/SR 748.126.3), based on the Investigation Report by the Air Accident Investigation Bureau on 19 September 2007.

General information on this report

In accordance with Annex 13 of the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Law, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent future accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident 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 prevention, due consideration shall be given to this circumstance.
The definitive version of this report is the original in the German language.

All times in this report, unless otherwise indicated, are indicated in the standard time applicable to the area of Switzerland (local time – LT), corresponding at the time of the accident to Central European Time (CET). The relationship between LT, CET and coordinated universal time (UTC) is: LT = CET = UTC + 1 h.

For reasons of protection of privacy, the masculine form is used in this report for all natural persons, regardless of their gender.

Final Report

Aircraft	Enstrom 480 helicopter			HB-XJQ	
Operator	Flugschule Eichenberger AG, Flugplatz, 5632 Buttwil				
Owner	Flugschule Eichenberger AG, Flugplatz, 5632 Buttwil				
Pilot	Swiss citizen, born 1959				
Licence	PPL (H)				
Flying hours	**total**	144 hours	**during the last 90 days**	0 hours	
	on the accident type	19 hours	**during the last 90 days**	0 hours	
Pilot (instructor)	Swiss citizen, born 1971				
Licence	CPL (H)				
Flying hours	**total**	2065 hours	**during the last 90 days**	114 hours	
	on the accident type	462 hours	**during the last 90 days**	46 hours	

Location	Chilenfeld, municipality of Geltwil		
Coordinates	667 000; 234 000	**Altitude**	655 m/asl
Date and time	19 March 2003, 16:40 LT		

Type of operation	VFR training
Flight phase	Climb
Accident type	Emergency landing after reduction in rotor speed conditional on technical reasons

Damage to persons

	Crew	Passengers	Third parties
Fatally injured	---	---	---
Seriously injured	---	---	---
Slightly injured or uninjured	2	---	

Damage to the aircraft Badly damaged

Damage to third parties There was no damage to third parties.

1 Factual Information

1.1 Pre-flight history and history of the flight

After a fairly long break in his flying activity, the private helicopter pilot wanted to make a training and check flight with the flying instructor.

In this connection, a flight was planned on the afternoon of 19 March 2003. After the instructor and trainee pilot had arrived at Buttwil aerodrome at 15:00 LT, they carried out an external check. The instructor asked some technical questions and also checked the pilot's knowledge in connection with the various instruments and switches in the cockpit.

In addition, a V_{ne} calculation was carried out and the H-V diagram was discussed. The helicopter then was started.

After a pedal turn, two circuits overhead Buttwil aerodrome were flown, with several exercises related to a possible engine failure when hovering plus three autorotations over the aerodrome with power recovery.

On the overflight to the Meerenschwand outlanding field, the instructor gave instructions for a further autorotation, which was aborted at 50 ft/GND. There followed a reconnaissance and an outlanding south of Meerenschwand.

After the approach briefing, the helicopter took off again and climbed to 3000 ft QNH. In the course of this climb, an instruction for a further autorotation was suddenly given. After the pilot had approached a suitable field, an instruction to go around was again given.

The instructor had envisaged carrying out another sudden autorotation from the south, on the return flight to Buttwil aerodrome. The helicopter therefore had to gain height again. This took place at a power setting of approximately 60 psi, corresponding to normal torque for the climb.

Approximately 5 to 10 seconds after initiating the climb, intense vibrations and a loud noise suddenly occurred. A complete loss of power then occurred and the helicopter turned to the left. The "LOW-Rotor RPM Warning" lit up.

According to the instructor's statements, at this time the helicopter was approximately 100 m above the ground.

The instructor immediately took control of the helicopter. Although he lowered the collective pitch lever, the speed did not increase. The instructor had the impression that the rotor was being braked. In order to avoid colliding with trees, the pilot had to carry out a change in heading of almost 90°.

When the instructor wanted to initiate the flare, he noticed that the rate of descent did not reduce; nor did the rotor rpm increase. He therefore had to reduce the rate of descent somewhat using the pitch and carried out a level-off at a relatively low forward speed.

Since the terrain was uneven and rising in front of the helicopter, on touching the ground its deceleration was such that it pitched forward. As it did so, the main rotor struck the tail. The helicopter turned approximately 45° to the left.

The pilot then switched off the turbine and the instructor switched off all systems and pulled the fuel shutoff handle.

1.2 Aircraft information

Type	Enstrom 480
Characteristics	Helicopter, full metal construction with skids, a turbine engine and a three-blade main rotor
Year of construction	1996
Serial number	5018
Engine	Allison 250-C20W
Certification	Private VFR day and night; commercial VFR day
Operating hours	1981:46 hours
Mass and centre of gravity	Maximum permitted take-off mass 1292 kg Mass at the time of the accident approx. 1160 kg
Airworthiness certificate	Standard category, sub-category normal, issued by the Federal Office for Civil Aviation on 16.12.1996
Maintenance	Last 50-hour check carried out on 10.03.2003 at 1956:00 hours
Fuel	Jet A-1 approx. 290 l on take-off of the flight involved in the accident

1.3 Meteorological information

The information below was provided by MeteoSwiss.

Allgemeine Wetterlage

Das Wetter in der Schweiz war durch ein Hoch mit Zentrum über England bestimmt. Es herrschte eine leichte Bisenströmung. Die Dunstobergrenze befand sich auf ungefähr 1500 m/M. Die Sicht betrug um 5000 m und es blies ein Wind aus Nord bis Nordost mit 3 bis 5 kt.

Translation:

General weather situation

The weather in Switzerland was affected by a high-pressure area centred over England. There was a light 'bise' wind. The haze ceiling was at approximately 1500 m/asl. Visibility was about 5000 m and the wind was blowing from the north to north-east at 3 to 5 kt.

1.4 Investigation

The accident took place at 16:40 LT. The investigation was opened on the same evening in cooperation with the Argovian cantonal police.

After an initial inspection it was found that the belt which transfers power from the engine shaft to the main transmission was damaged and had come off the pulleys at the front.

The two pulleys are normally kept at a specified distance by an H-strut and aligned so that the belt runs straight on the parallel pulleys (Annex 3).

On detailed examination and disassembly of the drive transmission it was found that the H-strut responsible for maintaining the correct distance between the lower and upper pulley was broken (Annex 2). In addition, the ends of the two drag links, which were supposed to ensure the correct alignment of the lower pulley, were torn.

As a result of this change in geometry, the belt had come off at the front and had braked the upper pulley.

The belt was damaged on its front side. This damage was the result of the fact that the belt had been deflected forwards by the broken H-strut, where it grazed the main transmission housing causing it to be braked.

The defective H-strut was examined. The investigation showed that cracks had formed where the H-strut had been welded during manufacture. The macroscopically brittle fracture ran along the weld seam of the cross-member and then relatively straight in the radial direction of the tube.

Consequential damage occurred at the surfaces of the fracture, making it impossible to draw any conclusions about the character of the fracture.

The metallographic examination showed that on the H-strut both cracks ran through the heat-affected zone of the weld. The matrix of the heat-affected zone exhibited a martensitic formation. In addition, there was evidence of fine heat-treatment on the inner edge of the tube.

The general examination of the helicopter showed no indications of defects in other systems or controls.

The emergency transmitter (ELBA) was not triggered by the accident.

2 Analysis

2.1 Technical aspects

The design of the drive belt arrangement was such that the rotor was inevitably braked as a result of the fracture in the H-strut and the resulting forward deflection. The freewheel clutch, which in the event of a loss of power is designed to disconnect the rotor from the engine, was installed in the reduction gear of the power train and its output drove the lower pulley. As a result of this design of the free-wheel clutch, it was unable in this case to perform its function, as the pulley was being braked directly at the input to the gearbox. This had a fixed traction link to the rotor via the gearbox.

The investigation showed that the crack on the H-strut had started in the area of the weld. The material had been aged there by the welding process.

2.2 Human and operational aspects

After the fault appeared, the flying instructor took control of the helicopter. Although he could not prevent a reduction in the rotor speed, because the displaced belt was braking the rotor, he still managed to make an emergency landing without injuring the occupants. His intervention was appropriate.

3 Conclusions

3.1 Findings

- The pilot and instructor were in possession of the appropriate licences.
- There were no indications of the pilots suffering any health problems during the flight involved in the accident.
- The helicopter was entered in the Swiss aircraft register and licensed for operation.
- At the time of the accident, the mass and centre of gravity were within the permitted limits.
- The last scheduled service was a 50-hour check, which had been carried out on 10 March 2003 at a total operating time of 1956:00 hours.
- Servicing was carried out by a company licensed according to JAR-145 and certified by an authorised license holder.
- No airworthiness directives were applicable to the helicopter.
- The last status check was carried out by the Federal Office for Civil Aviation on 20 June 2000 and did not note any complaints.
- The maintenance programme does not provide for any specific inspection of the H-strut for damage. According to the maintenance programme, only a general visual check of this strut is required on the 100 hours inspection.
- The hardness measurements showed that in the heat-affected zone of the weld on the H-strut there was a seriously aged matrix.
- A fracture occurred in the H-strut and as a result the axes of the two pulleys were no longer parallel. Consequently, the drive belt was deflected forwards, where it was braked on the housing.
- The weather had no influence on the occurrence of the accident.

3.2 Cause

The accident is attributable to the fact that normal autorotation could not be carried out because the main rotor was being braked as a result of damage in the power transmission system. The layout of the main rotor free-wheel clutch was unable to prevent this.

The damage to the power transmission system is possibly attributable to inappropriate treatment of material during manufacture.

4 Safety recommendations

4.1 Safety deficit

The rotor speed dropped during a training flight on an Enstrom 480 type helicopter, equipped with a turbine. Normal autorotation was not possible.

The investigation showed that the main rotor was braked as a result of damage to the main rotor's power transmission system. The free-wheel clutch, which was supposed to ensure that the main rotor can continue to turn even after damage to the engine or power transmission system, is installed at the output from the engine on this type of helicopter. In the case of damage to the downstream power transmission system, it is therefore ineffective.

On the same helicopter type with the same type certificate, but with a piston engine, the free-wheel clutch is fitted at the input to the main transmission.

4.2 Safety recommendation No. 397

The FOCA is to approach the helicopter's licensing authority to demand an examination of the layout of the free-wheel clutch. It must be ensured that normal autorotation can be carried out even if damage occurs to the power transmission system.

4.3 Actions taken since the accident to improve flight safety

The rotor speed dropped during a training flight on an Enstrom 480 type helicopter, equipped with a turbine. Normal autorotation was not possible.

The investigation showed that the main rotor was braked as a result of damage to the main rotor's power transmission system. The damage to the power transmission system was caused by the fracture of the H-strut. According to the maintenance programme, only a general visual check of this strut is required.

The manufacturer has issued the service directive bulletin No. T-018 on 16 june 2003, in which a detailed procedure for the inspection of the welding seams is described. The inspection has to be carried out every 100 hours.

However, the maintenance programme for the 100 hours inspection has not been adapted as for today.

Berne, 25 March 2011

Federal Aircraft Accident Board

André Piller, President

Tiziano Ponti, Vicepresident

Ines Villalaz-Frick, Member

Annex 1

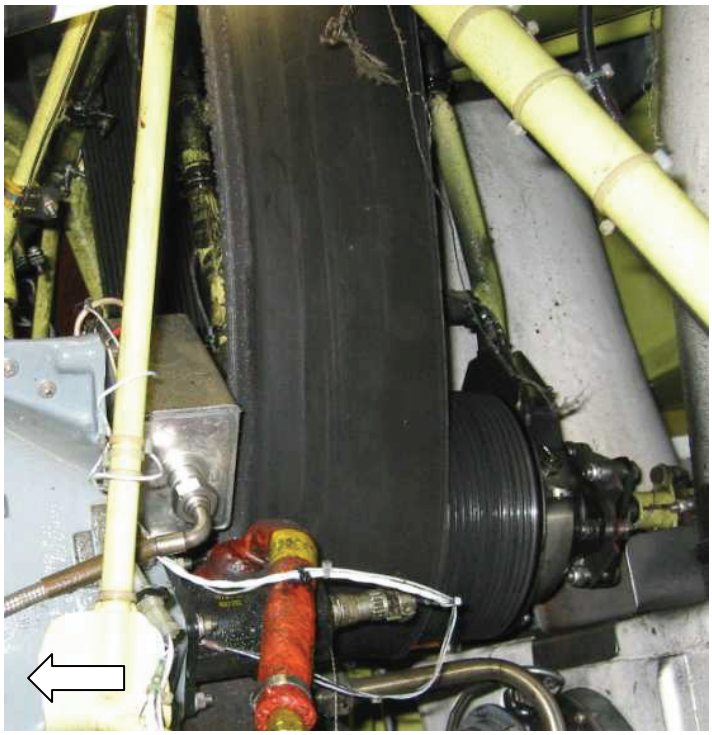
View of accident site and Helicopter

View of accident site looking approximately direction south

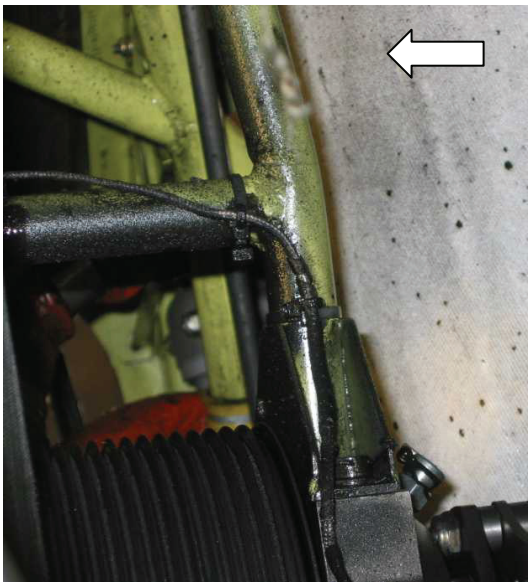
View of accident site looking approximately direction north

Annex 2

View of the defective H-strut



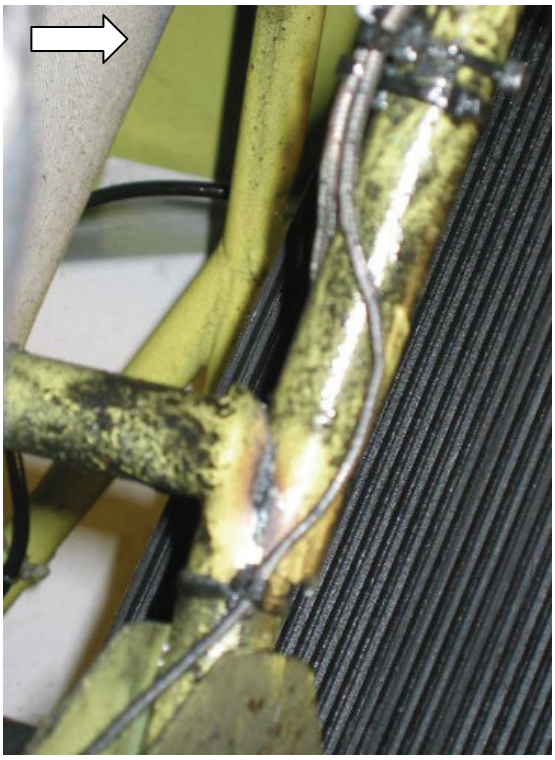
H-strut with belt deflected towards front in situ



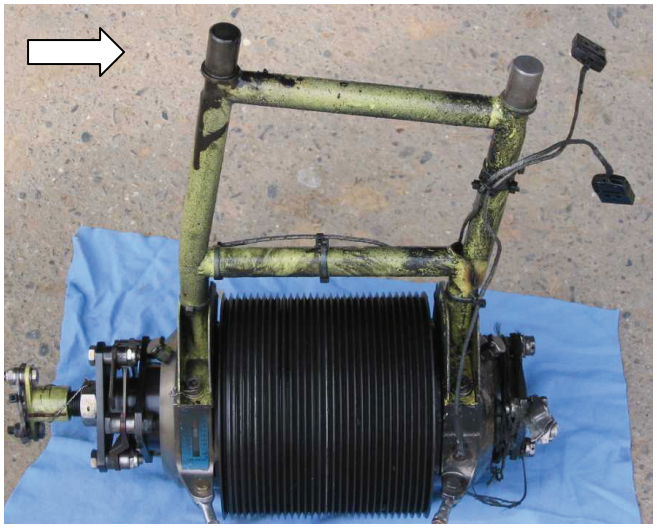
Rear Tube of the H-strut

Indication of direction of flight

Broken forward tube of H-strut

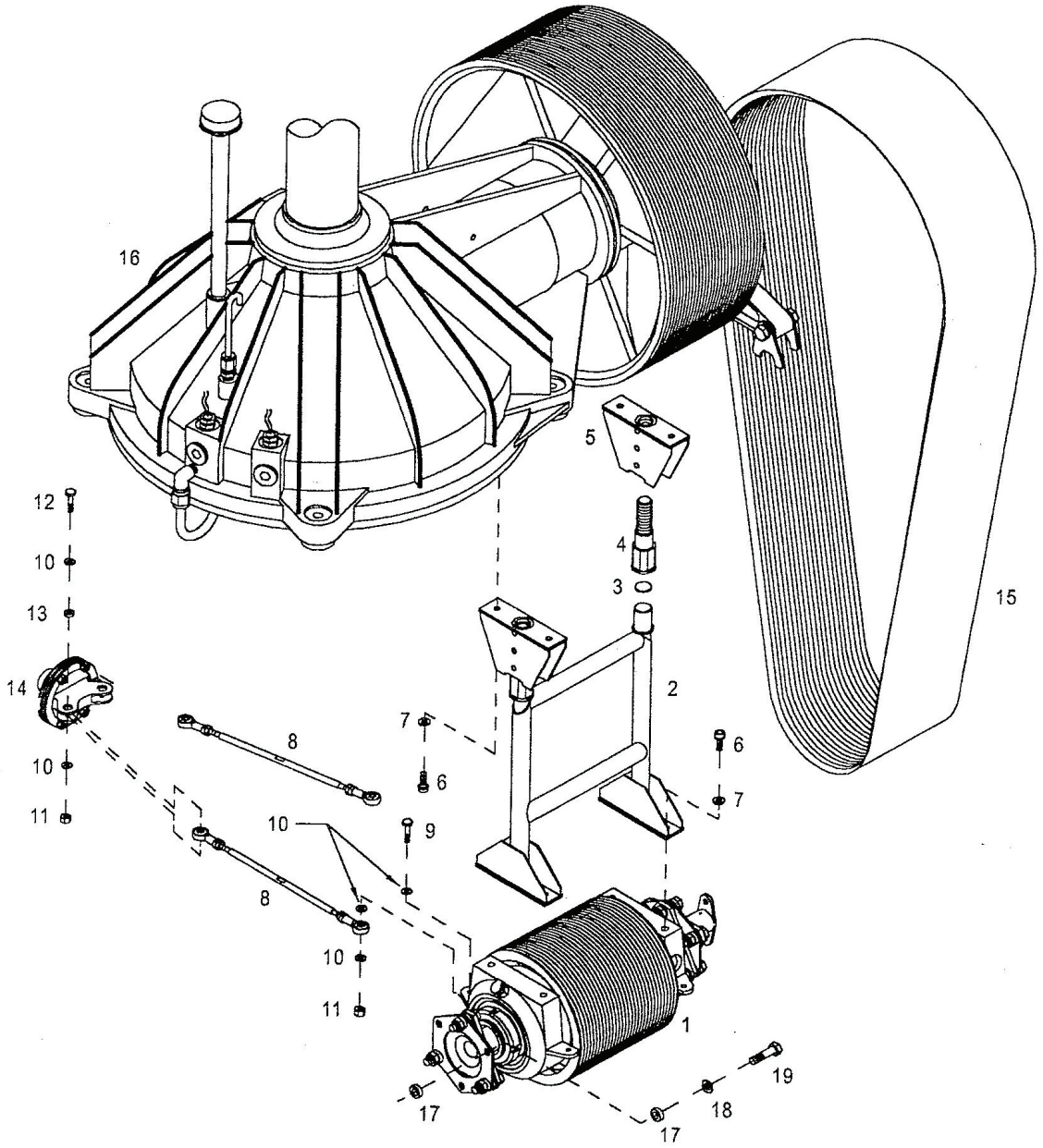


Lower pulley with H-strut



Annex 3

Enstrom TH-28/480 Lower Pulley Drive System



1.	Lower Pulley Assembly	11.	Nut
2.	H-Strut	12.	Bolt
3.	Bearing	13.	Spacer
4.	Jackscrew	14.	Isolation Mount
5.	Tension Mount	15.	Drive Belt
6.	Bolt	16.	Main Rotor Transmission
7.	Washer	17.	Spacer
8.	Tie Rod	18.	Washer
9.	Bolt	19.	Special Bolt
10.	Washer		