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Aircraft Accident Investigation Bureau AAIB

Final Report No. 1967 by the Aircraft Accident Investigation Bureau

concerning the accident

to the Robin HR200/160 aircraft, registration HB-KFA

on 23 September 2005

municipality of Collombey-Muraz, hamlet of Peutet

14 km south of Montreux

Ursache

Der Unfall ist darauf zurückzuführen, dass sich das Flugzeug anlässlich einer Notlandung nach einem Motorausfall überschlagen hat. Der Motorausfall wurde wahrscheinlich verursacht durch den Bruch des Kabels des Gemischhebels.

Folgende Faktoren können zum Unfall beigetragen haben:

- Unzweckmässige Montage und Regulierung des Kabels des Gemischhebels am Gemischhebel.

General information on this report

This report contains the AAIB's conclusions on the circumstances and causes of the accident which is the subject of the investigation.

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 French 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 Summer Time (CEST). The relationship between LT, CEST and coordinated universal time (UTC) is: $LT = CEST = UTC + 2 \text{ h}$.

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

Final Report

Aircraft	Robin HR 200-160 s/n 0331	HB-KFA
Operator	Groupe de vol à moteur du Chablais, 1880 Bex	
Owner	Groupe de vol à moteur du Chablais, 1880 Bex	
Pilot	Swiss citizen, born 1975	
Licence	Private pilots' licence PPL (A), issued on 15.09.2005 by the Federal Office for Civil Aviation	
Flying hours	total 53:24 h	during the last 90 days 18:17 h
	on the accident type 50:49 h	during the last 90 days 16:02 h
Location	Illarsaz /VD	
Coordinates	560 300 / 128 450	Elevation 383 m AMSL
Date and time	23 September 2005 at 16:55 LT	
Type of use	Private VFR	
Flight phase	Descent for landing	
Type of accident	Engine failure, emergency landing	
Injuries to persons		
	Injuries	Crew Passengers Other persons
	Fatal	--- --- ---
	Serious	--- --- ---
	Slight/none	1 --- ---
Damage to the aircraft	Badly damaged	
Damage to third parties	Impact traces on the ground	

1 Factual information

Preliminaries

On 23 September 2005, the pilot arrived at approximately 08:30 LT at Bex aerodrome to make a VFR flight to Lausanne - La Blécherette.

On the ground, the pilot carried out exercises to familiarise himself with the instruments in the cockpit. He then found that when the mixture control was moved to the RICH position, the stop on the carburettor was reached even though the lever had not yet reached the corresponding position. When the latter is positioned correctly, it systematically moved back about 5 mm.

After carrying out flight preparations and the usual checks, the pilot took off at about 09:25 LT for Lausanne aerodrome at the controls of the Robin HR200-160, registration HB-KFA. He said he did not notice anything unusual, stating that the mixture control was working correctly.

This first flight proceeded normally, at an altitude of 4500 ft and without setting the mixture leaner. After landing, the engine was stopped by making the mixture leaner, in accordance with the procedure indicated in the flight manual.

At 15:30 LT, the pilot made the return flight to the Placettes airstrip at Bex without any problems, proceeding in the same way as during the morning flight and at a similar altitude.

Since HB-KFA was not subject to any other reservation, the pilot decided to make another Alpine flight.

History of the flight

At 16:12 LT, the pilot took off solo on board from Bex aerodrome to make for the pass of La Croix. Passing 7000 ft, he made the mixture leaner for the first time, whilst continuing his climb. When he reached cruising altitude of 10,000 ft in the region of the Tsanfleuron glacier, he corrected the mixture, acting in the same way as before. The flight continued perfectly normally towards Les Dents du Midi and Emosson Lake. At this point, the pilot started his descent towards Vouvry to return to his starting point.

According to his statements, the pilot made the two corrections to the mixture without noticing any resistance on the control. He added "*Avant d'initier la descente, que j'ai effectuée avec un taux de 1500 ft/min et 2500 tours/min, j'ai poussé complètement sur la commande de mélange. (...) En poussant sur la commande, j'ai eu le sentiment que tout était normal. Par la suite je n'ai plus actionné la commande de mélange jusqu'au moment d'effectuer l'atterrissage d'urgence.*", that is: Before starting the descent, which I made at a rate of 1500 ft/min and at 2500 rpm, I pushed the mixture control fully. (...) When I pushed on the control, I felt that everything was normal. After that, I did not operate the mixture control again until the moment I made the emergency landing.

Between Vouvry and waypoint November, at an altitude of 3000 ft, the engine suddenly lost power. It finally stopped 30 to 40 seconds later.

As the pilot realised that he would not be able to make it back to Bex aerodrome, he decided to make an emergency landing in a cultivated field. Before landing, he pulled on the mixture control which remained in his hand to enable him to cut the fuel supply to the engine.

The aircraft landed on its main landing gear. When the nosewheel touched the ground, it collapsed. The aircraft slid for some thirty metres, then flipped over before coming to a standstill on its back. The aircraft suffered major damage.

Fire did not break out and the pilot, unharmed, exited the cockpit unaided. He informed the chief instructor at Bex using his mobile telephone.

The maintenance company manager did not inform the Aircraft Accident Investigation Bureau and had the wreck conveyed by helicopter to the Bex aerodrome hangar. He also drained the fuel tank.

Aircraft information

Manufacturer:	Robin Aviation
Type and serial number:	HR200/160 s/n 0331
Year of construction:	1999
Characteristics:	Tow-seater, metal, low-wing with fixed tricycle landing gear
Engine:	4 cylinder piston engine
Manufacturer and type:	Textron Lycoming O-320-D2A
Year of construction:	1999
Serial number:	L-18962-39A
Carburettor:	Precision MA-4SPA, p/n 10-5135 s/n CK919218
Propeller:	Sensenich, 74DM6S5-2-66 s/n A58456
Registration certificate:	Issued by the Federal Office for Civil Aviation (FOCA) on 26.09.99.
Airworthiness certificate:	Issued by the FOCA on 06.07.99, inspection for renewal of the airworthiness certificate on 14.03.05, certificate valid until 14.03.07.
Area of use:	VFR by day and by night, non-commercial operation

Flying hours at the time of the accident

Airframe:	2909:48 hours, of which 17:24 hours since the last 100 hour check carried out on 05.09.05.
Engine:	2909:48 hours, of which 676:54 hours since the last general service carried out on 21.01.2004 and 17:24 hours since the last 100 hour check carried out on 05.09.05.
Last FOCA inspection:	14.03.05 at 2615:42 hours. The inspection report was signed by the manager of the maintenance company.

Wreckage information

The wreck was conveyed by helicopter to Bex aerodrome and placed upside-down in a hangar on the day of the accident.

The nosewheel, bent backwards, had partially torn the firewall.

Damage was also found to the main landing gear, fuselage, tail, glass roof and both wings.

Findings on the engine and propeller

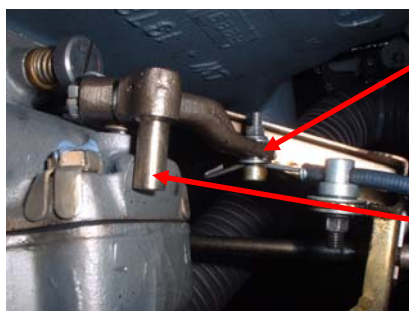
- The power lever was found in the idling position.
- The control of the carburettor pre-heater on the control panel was pushed in and the flap in the heater box was on cold. The carburettor pre-heater box was slightly damaged on impact.
- The fuel shut-off control was pulled out.
- The position of the control switch for the electric fuel pump was set to OFF. When the aircraft was examined, the pump was working perfectly and the filter did not indicate any particular impurity.
- All the Champion type REM 38E spark plugs were removed. The electrodes were of the correct colour and were in working condition. The 4 lower spark plugs were slightly leaded.
- The aircraft was equipped with an exhaust gas temperature (EGT) indicator.
- It was not possible to determine the position of the magneto selector on impact. The key had been removed before the wreck was examined.
- On the propeller, only blade No. 1 was bent back 15° from the centre of the blade. The two blades did not exhibit any damage or particular impact on the leading edges.

Mixture control information

The "piano wire" cable of the mixture control is made of treated steel, 1.3 mm in diameter, crimped at the panel end to a rigid tube 5 mm in diameter and 100 mm long; the latter acts as a sliding guide in the sheath. The sheath is fixed on the centre console by a lock-nut.

At the carburettor end, this cable is fixed by a cable clamp consisting of a perforated "Allen" hex screw, a washer, a spacer and a nut.

In section 7-6-2, the maintenance manual states: "*Réglage de la commande de mixture: Amener la tirette à 2 mm de la console et fixer le câble sur l'équerre du carburateur. La butée "pauvre" est réalisée par le téton dépassant sous l'équerre et ne nécessite par conséquent aucun réglage.*", that is: Adjustment of the mixture control: bring the pull-out knob 2 mm from the console and fix the cable onto the corner plate of the carburettor. The "lean" stop is constituted by the lug passing under the lever (set square) and therefore does not need any adjustment.



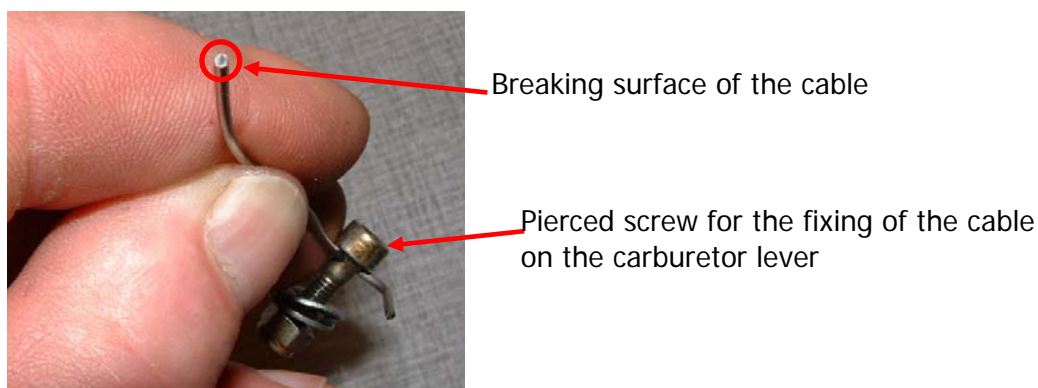
Fixing of the mixture control cable on the carburetor lever

Lug in the "lean" stop position

Mixture control on a carburetor of type Precision MA-4SPA

Findings on the mixture control

- The mixture control's "piano wire" cable broke 25 mm outside the sheath, on the carburettor side, in the pushed-in (RICH) position.
- The other part of the cable, 45 mm in length, was still fixed to the carburettor mixture lever. This value represents the distance measured from the centre of the perforated screw on the carburettor corner plate to the break point.
- When the assembly was checked, whereas the control was positioned at RICH, a cable segment 15 mm long was measured outside the sheath on the carburettor side. The control was therefore not adjusted according to the maintenance manual data. Moreover, the pilot confirmed that when the mixture control was in the RICH position, it moved back about 5 mm of its own accord.
- The travel of the mixture lever was measured on the carburettor during the examination; a clearance of 45 mm was found.
- On the carburettor mixture lever, the perforated screw of the cable clamp was mounted vertically, with the head at the top. This assembly was inverted 180° compared with the manufacturer's instructions. These specify that the perforated screw of the control's cable clamp on the mixture lever must be positioned from bottom to top. Hence, given this inverted assembly, the cable was offset upward by about 10 mm in relation to its normal operating position, and this accentuated the bend in the cable and increased its resistance when it moved inside the sheath. This assembly configuration certainly increased the fatigue effect on the material (Annex 1).
- The sheath, total length 92 cm, was twisted and covered by another heat-shrink protective sleeve. The sheath's cable clamp, fixed by means of a bracket on the carburettor pre-heater, slightly damaged a few turns of the sheath in the fixing area. The sheath exhibited a distinct upward bend.
- The break in the "piano wire" control cable is due to fatigue. The analysis report states that the break presents normally on the surface, without any macroscopically identifiable deformation. The areas of the edges have suffered secondary damage in places. From the macroscopic viewpoint, the typical characteristics of a fatigue break in the form of streaks can be recognised; these occur over approximately 40%. Given the orientation of the break, one can suppose that the force causing this break is the result of a unilateral bending stress superimposed on a slight torque effect. Despite the secondary damage observable on the surface of the break, streak marks due to vibration can be seen in places. The break due to the residual force exhibits the typical characteristics of a ductile break, in the form of fine pitting.



Mixture control, breaking surface

- The carburettor mixture lever was able to pivot freely. A detailed inspection of the carburettor did not reveal any anomaly.
- The maintenance procedures, as well as the manufacturer's maintenance manual, do not impose any time limit on the use of the mixture control or any particular inspection. However, checking the "efficiency of the mixture control", "the condition of the sheath" and "efficiency of the sheath stop" are recommended.

Additional information

- The technical documents of aircraft HB-KFA do not mention any replacement of the mixture control.
- Between entering into service on 26 May 1999 and the flight involving the accident which is the subject of this report, HB-KFA has had five incidents or even accidents, three of which have required the engine or carburettor to be removed.
- According to the statements of the maintenance company supervisor, the quantity of fuel on board was 75 l.
- The prescribed limits for mass and centre of gravity were complied with.
- The pilot did not make a distress call.
- The result of the analysis of a sample of fuel taken after the accident mentioned values which were within the tolerances.
- Examination of the oil filter did not reveal any particular impurity.

Meteorological information according to MétéoSuisse

Situation générale

Un faible anticyclone s'étend de la mer baltique aux Alpes. Il se décale lentement vers l'est mais détermine le temps en Suisse.

Conditions météorologiques à l'endroit de l'accident au moment de l'accident:

*Nébulosité: 1/8, base autour de 7200 ft AMSL,
6/8, base autour de 32 000 ft AMSL*

Temps: -

Visibilité: 15 km

Vent: nord 2 kt, coups de vent autour de 5 kt

Température/point de rosée: 20 °C / 12 °C

Pression: QNH LSGG 1017 hPa, QNH LSZH 1017 hPa

Position du soleil: azimut: 241°, élévation: 23°

Dangers: néant

Translation:

General situation

A weak anticyclone extends from the Baltic to the Alps. It's slowly eastwards but determines the weather in Switzerland.

Weather conditions at the time and location of the accident:

Clouds: 1/8, base approximately 7200 ft AMSL,
6/8, base approximately 32,000 ft AMSL

Weather: -

Visibility: 15 km

Wind: north 2 kt, gusting to approximately 5 kt

Temperature/dew point: 20 °C / 12 °C

Pressure: QNH LSGG 1017 hPa, QNH LSZH 1017 hPa

Position of the sun: azimuth: 241°, elevation: 23°

Hazards: none

End of translation

2 Analysis

2.1 Technical aspects

It is probable that the cable linking the mixture control to the lever on the carburettor broke after the pilot made the engine mixture leaner at 10,000 ft. Hence, at the time the aircraft was at 3000 ft, the mixture, which became even leaner during the descent, may have caused the engine to stop.

The inadequate assembly configuration, which raised a segment of cable in excess of 15 mm, together with the misalignment, may explain the way the mixture control broke.

The break in the mixture control cable may be explained by the conjunction of two factors: on the one hand the inadequate assembly of the cable clamp on the carburettor mixture lever and on the other hand the incorrect adjustment of the mixture control (Annex 1).

2.2 Operational aspects

When the engine began to lose power, finally stopping 30 to 40 seconds later, the aircraft was at an altitude of 3000 ft and too far away from Bex aerodrome to attempt to return. The pilot had no other option than to make an emergency landing. Seeing an area which seemed to him to be suitable for this manoeuvre, the pilot landed his aircraft in a field of carrots. The nature of the ground caused the nosewheel to break and the aircraft to overturn.

The flying technique adopted by the pilot was adequate and enabled the aircraft to be controlled as far as the ground, avoiding a stall which could have had serious consequences.

The environment appeared suitable for a successful emergency landing, given that the dimensions of the field allowed the aircraft to come to a complete halt. However, from his aerial position, the pilot found it difficult to determine the type of ground.

3 Conclusions

3.1 Findings

- The pilot had been the holder of a private pilots' licence for aircraft PPL(A) since 15.09.2005.
- The medical examination took place on 08.11.2004. The certificate includes the mention VDL (spectacles wearer).
- The prescribed limits for mass and centre of gravity were complied with.
- The aircraft was rated for VFR day and night flying.
- The pilot did not make a distress call.
- Between entering into service on 26 May 1999 and before the accident which is the subject of this report, HB-KFA had five incidents or even accidents, three of which required either the engine or the carburettor to be removed.
- The last inspection of the aircraft by the FOCA was on 14 March 2005. The inspection report was signed by the manager of the maintenance company.
- Apart from the break in the mixture control, the visual inspection of the airframe and engine did not reveal any technical fault likely to have played a role in this accident.
- The weather conditions did not influence the accident.

3.2 Cause

The accident is due to the aircraft overturning during an emergency landing following an engine failure probably caused by the break in the mixture control cable.

Factors which may have played a part in the incident:

- Inadequate assembly and adjustment of the mixture control cable on the mixture lever.

Berne, 17 October 2007

Aircraft Accident Investigation Bureau

This report contains the AAIB's conclusions on the circumstances and causes of the accident which is the subject of the investigation.

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Fig. 1 Mixture control, incorrect assembly

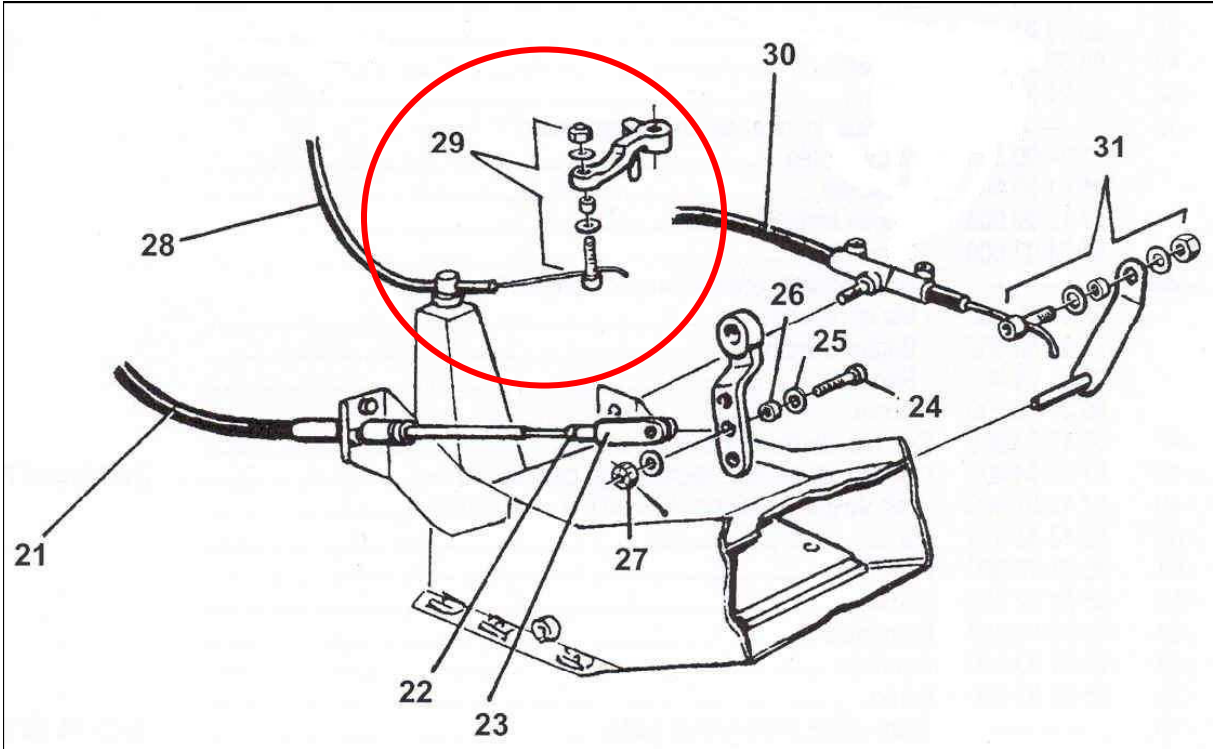


Fig. 2 Mixture control, assembly according to the manufacturer's manual