

## Investigation Report.

Status: **Final**  
Date: **22 JUN 08**  
Time: **11.40 UT**  
Type: **Piper PA 18-150**  
Operator: **Private**  
Registration: **D-EFXY**  
C/N : **4891;**  
msn : **18-4963**  
Manufacturing Date: **1956**  
Engine(s): **Lycoming O-360-A3A**  
Crew: **Fatality: 0 / Occupants: 1**  
Aircraft Damage : **Total Loss**  
Location: **In a hangar, near the Luchtvaartstraat, Kiewit.  
N 50°58,148'  
E 05°21,825.**  
Phase: **In Flight.**  
Nature: **Aerial works, glider towing**  
Departure Airport: **EBZH**  
Destination Airport: **EBZH**  
Flight Number: **N/A**

### **Narrative:**

The aircraft was used by the gliders club located on Kiewit airfield for the aerotow of gliders. This aircraft was recently leased from its Dutch owner, in order to temporarily replace the club's dedicated aircraft, a Robin DR400 undergoing maintenance.

The aircraft was first used by the gliders' club the week-end before, and intensively used during the week-end when the accident occurred.

The aircraft took off for the eleventh time on Sunday 22 June, at 11:38 with a towed Grob Twin Astir glider, registered OO-ZEY.

Rapidly after take-off, when reaching an altitude of 300 ft, the engine stopped.

The pilot realized he could not continue straight ahead, due to the presence of houses and trees. He was also too low to hope to return to the airfield. He decided to turn to the left, and attempt to land on the roof of hangars adjoining the road leading to the airfield (Luchtvaartstraat).

The pilot wiggled the wings, in order to signal the glider to release the rope, and turned to the left. The sign was not identified by the glider's pilot, who saw that the towing aircraft descended lower than the glider, and steering to the left with the tow rope still attached.

REF: AAIU (Belgium) 2008-14.

The glider pilot finally released the rope, and performed a U-turn to land back on the runway.

The towing pilot concentrated on flying the aircraft. After having hit a tree, the aircraft went straight into the sidewall of the hangar, hitting a frame supporting the roof.

The pilot exited the aircraft safely, and only suffered minor injuries.

The aircraft was totally destroyed.



Flight Path

**Enquiry.**

**Pilot**

Sex: Male

Age: 45 years-old

Nationality: Belgian

Licence: PPL (A), first issued in April 1999, delivered 17/06/2005 valid until  
24/07/2008

Medical: Class 2, valid until 02/07/2009

The pilot had a total of 1200 FH, on Single Engine aircraft, from which 700 FH on Piper PA-18.

**Aircraft**

**Airframe**

Manufacturer: Piper Aircraft Corporation

Type: Piper PA-18-150

Serial Number: 18-4963

Built year: 1959

Registration: D-EFXY

Certificate of Registration: L 4891

Certificate of Airworthiness: 4891

Annual Inspection: Performed on 3 June 2008.

Total Flight Hours: 3467,5 FH.

**Engine**

Manufacturer: Lycoming

Type: O-360-A3A

Serial: L-2230-36E

Power: 180HP

TSO: 127 FH

**Propeller**

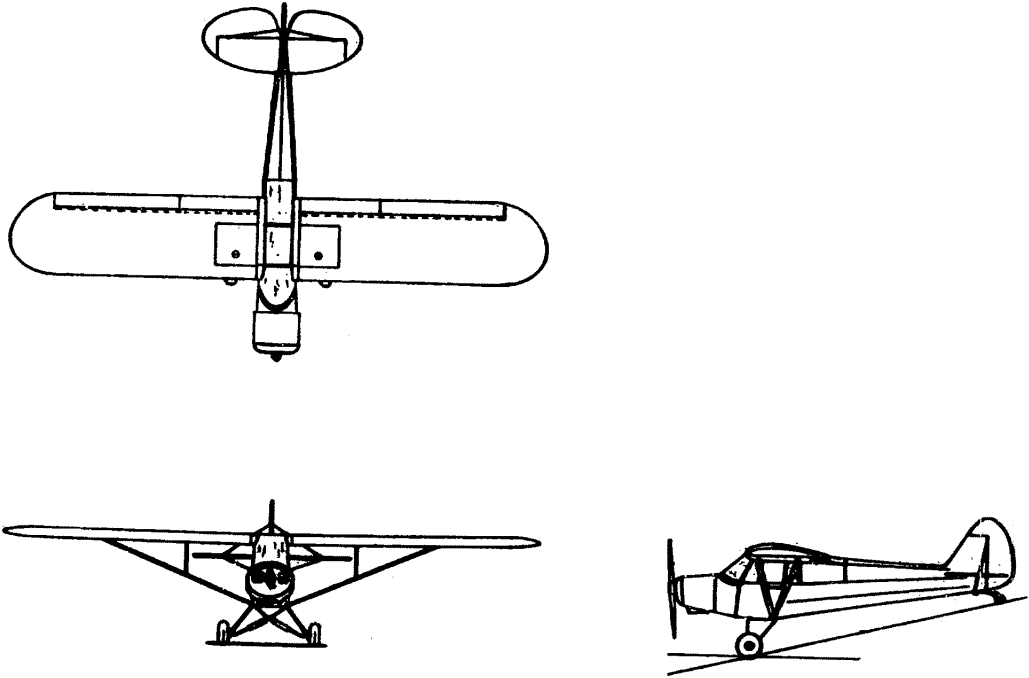
Manufacturer: Hoffman

Type: HO 4/27M-A170 110

Serial: J8854

**Owner**

CNE Belegging B.V.



**Maintenance.**

The aircraft was maintained in accordance with the manufacturer's maintenance programme, each 50 and 100 FH /annual check.

The annual check was last performed and certified on 3 June 2008.  
The 50 FH inspection was last performed on 14 May 2008.

The aircraft was modified in accordance with

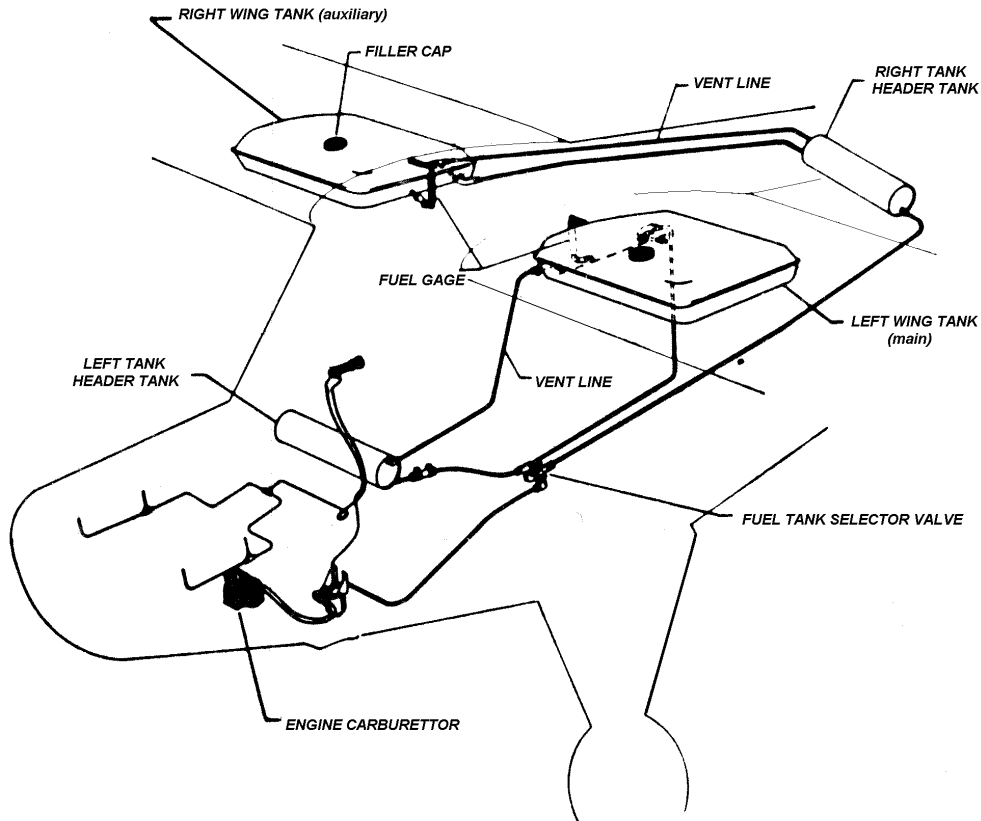
- FAA STC Nr SA36RM, issued to David C. Johnson; installation of a Lycoming O-360-C2A or O-360-A3A 180 HP performed on 28 April 2007.
- LBA STC Nr SA1150 – modification to the towing system.

**Meteo.**

The meteorological conditions had no influence on this accident.

**Analysis.**

**Aircraft Fuel System**



The Piper PA-18 is equipped with 2 Fuel Tanks (capacity 18 USG). A small (approx. 2 quarts) header tank which serves to maintain constant fuel flow regardless of the normal attitude of the airplane is included in the installation of each fuel tank. The header tank for the left fuel tank is located forward of the instrument panel; for the right tank it is located behind the rear seat.

Fuel indicator gauges are installed in the upper cabin panels, and are visible from either seat. The fuel tank selector valve is mounted on the left cabin panel near the front seat.

The engine is fed through a line going from the fuel tank selector valve to the carburettor.

The system is completed by fuel filters and a primer pump.

REF: AAIU (Belgium) 2008-14.

With the installation of a 180 HP engine (replacing the original 150 HP engine), important changes were introduced in the fuel system. These changes included:

- a new carburettor air box
- replacing the 3/8" fuel line of the LH fuel tank by a 1/2" line
- modifying the Fuel Filler Caps of both tanks (vented caps)

These changes were required to ensure that the fuel flow to the engine could be maintained at all engine ratings and aircraft attitudes. Nevertheless, for critical conditions (high pitch angle, warm outside temperature,...) the changes alone are not sufficient; therefore an operational limitation was introduced in the Aircraft Flight Manual.

The Airplane Flight Manual must include a dedicated supplement, and changes are to be brought to placards inside the cockpit to reflect the limitations. These changes indicated that;

- the LH Tank is to be considered as the main tank,
- only the LH Tank is to be used for take-off and landings.
- the LH Tank usable fuel quantity is reduced to 9 USG.
- the RH Tank is to be considered as an auxiliary tank, and be used only for level flights.



**LH Fuel Tank (Main) gage  
as per STC SA36 RM**

The aircraft (D-EFXY) incorporated these changes; the Airplane Flight Manual showed (in the German language) an adequate supplement.

REF: AAIU (Belgium) 2008-14.

The placards inside the cockpit were only partially modified:

- On the fuel selector valve, there were no indication of Main /Auxiliary tank
- The graduation on the LH gauge was not modified to show the “empty” graduation at 9 USG.
- On the LH fuel gauge, the text indicating the use of the main tank was repeated.



Fuel Tank Selector Valve (on D-EFXY)



Fuel Tank Selector Valve (Correct configuration as per FAA STC SA 36 RM)

REF: AAIU (Belgium) 2008-14.

According to these limitations, it must be quite difficult to operate such aircraft for aerotow in accordance with the Aircraft Flight Manual supplement. Considering that, in this particular case, a typical flight would last 7 minutes, and be comprised of a take-off, a climb to the release altitude as fast as possible (average 5 minutes), release the gliders, and descend as fast as possible to service another glider. The gliders' club log show a transit time (from landing of the tow aircraft to the following take-off) of 1 to 2 minutes.

With these conditions, the aircraft would never be in level flight, therefore never meet the conditions for using the RH Fuel Tank, and the LH Fuel Tank has only 9 USG usable. This means a (theoretical) maximum operating time of 46 minutes, or 7 flights, before going for refuel.

Nevertheless, the limitation introduced in the Aircraft Flight Manual supplement is based on an accurate risk assessment, and flying outside this limit will lead, in critical conditions, to fuel feed problems.

#### **Findings on D-EFXY.**

On the crash site, the investigating team disconnected the two header tanks, and there was no fuel found in the RH Header tank. The position of this header tank during the crash and the further displacement of the wreckage prior to the finding indicate that the RH Header tank was empty at the moment of the crash.

The pilot had selected the RH Tank before take-off, and did not change the selection during the flight.

Therefore, it is reasonable to assume that the engine stopped by fuel starvation.

There were 35 liters of fuel remaining in the LH Fuel Tank.



### **Fuel Consumption.**

The aircraft was used the whole day before (21<sup>st</sup> June 2008). The log book indicates that the aircraft flew 2 hours and 24 minutes before refuelling (total 104 liters). This gives a calculated fuel consumption of ca 43 liters per hour.

This figure, although quite high (the average consumption for other 180HP-equipped PA18-150 is around 28-30 liters per hour) has been verified with figures of May 2005; the average was around 44 liters per hour.

The difference of consumption may come from the following:

- difference of efficiency of propellers (most Belgian PA-18 have a 2-blade propeller, while D-EFXY had a 4-blade Hoffman propeller.
- difference in the counting of time; on D-EFXY, the counting was done on the RPM-meter, while on Belgian aircraft, the counting is done by a separate hour-meter.
- although not found on the wreckage, there is a possibility to install the fuel filler cap so that the vent tube faces backward (instead of facing forward). In this configuration, fuel escapes from the fuel tank due to the pressure drop caused by the speed of the aircraft.

The hour meter incorporated in the RPM meter shows a value of 4064.79 hours; its value recorded on 15/06/2008 (begin 21/06) was 4060.09 hours, giving an operating time of 4.7 hours for the 2 days (21 and 22/06/2008).

Taking these data into account, the quantity of fuel remaining on board at the time of the crash would have been around 35 liters; i.e. the quantity that was retrieved from the left tank.

The gliders' club log figures (4.3 hours) shows a difference of 24 minutes with the RPM meter indication (4.7 hours). The logs show 24 flights for the 21/6/2008 and 10 flights on the 22/6/2008, the flights are counted individually, with an average of 7 minutes. A small imprecision on each flight repeated 34 times might lead to such variation.

The pilot used first the LH Tank, at the beginning of the day, until the fuel reached the ½ (empty) marker, then he used the RH Tank. He stated he was puzzled by the markings next to the LH Fuel Tank gauge, (Start und landung auf linkem tank – nur 36 ltr ausfliegbar), but could not get an explanation.

### Causes.

The aircraft crashed due to fuel starvation. This was influenced by the following factors:

- the high rate of flights (transit time of 2 to 1 minutes) pushing the pilot to maximize the use of the on-board fuel.
- an average fuel consumption higher than the fuel consumption of PA-18 usually flown by the pilot.
- a misunderstanding of the operating conditions defined in the Aircraft Flight Manual of this particular aircraft; in particular the limitations pertaining to the use of the fuel tanks. Flying outside the limitations set in the AFM.
- markings on the fuel selector valve and fuel gauges not complying with the applicable STC.
- possible major differences between aircraft of the same type, giving the pilot a false feeling of confidence. (Same Piper PA-18, but possible different fuel system configurations, different propellers, different engines).
- unreliable and imprecise fuel quantity measuring system (gauges).

### Safety Recommendations.

1. To BCAA

Make sure that the STC Nr SA36RM is correctly applied, in particular the markings on the gauges and selector valve plate, on all OO-registered aircraft

**Response of BCAA: the check was performed, and corrections applied when necessary; action is closed.**

2. To Belgian aeroclubs users of Piper PA-150 equipped with a 180hP engine.

Take note of the conclusions of this report, in order to sensibilise all concerned pilots

- of the importance of reading and understanding the Aircraft Flight Manual,
- of the possible big differences that may exist between aircraft of the same type.
- of the importance of taking sufficient safety margin.

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