Federale Overheidsdienst Mobiliteit en Vervoer
Service public fédéral Mobilité et Transports
Luchtvaart-Transport aérien

Air Accident Investigation Unit
-
CCN
Rue du Progrès 80 Bte 5
1030 Brussels

FINAL REPORT ON THE ACCIDENT TO GRUMMAN AA-1-B (OO-PMS) IN CHARLEROI ON JULY 28,2007

Ref. AAIU-2007-11
Issue date: 24 January 2008
Status: Final

Table of Content.

FOREWORD

This report is a technical document that reflects the views of the investigation team on the circumstances that led to the accident,

In accordance with Annex 13 of the Convention on International Civil Aviation, it is not the purpose of aircraft accident investigation to apportion blame or liability. The sole objective of the investigation and the Final Report is the determination of the causes, and define recommendations in order to prevent future accidents and incidents.

In particular, Article 13 of the Royal Decree of 9 December 1998 stipulates that the safety recommendations made in this report do not constitute any suspicion of guilt or responsibility in the accident.

Unless otherwise indicated, recommendations in this report are addressed to the Regulatory Authorities of the State having responsibility for the matters with which the recommendation is concerned. It is for those Authorities to decide what action is taken.

The investigation was conducted by L. Blendeman, assisted by MM M. Bourguignon and H. Metillon from the General Aviation Directorate of DGTA/DGLV, and by the Charleroi Airport Inspection team.

NOTE: For the purpose of this report, time will be indicated in UTC, unless otherwise specified.

Synopsis

Date and hour of the accident

Saturday, 28 July 2007, around 17.10 UTC.

Aircraft
Type: Grumman AA-1B
Registration: OO-PMS

Accident Location:
Charleroi Airport

Aircraft Owner
Air Rent Services

Type of flight
Navigation flight

Persons on board
1 Pilot and 1 Passenger

Abstract.
The Grumman AA1-B, registered OO-PMS took-off from Charleroi airport at 14.55 for a navigation flight.
The aircraft went to Middelburg, NL, via Feluy and Afflighem, the aircraft went around Walcheren, and intended to come back to Charleroi, via Zeebrugge, Brugge, Tielt, Afflighem, then on to Feluy and Waterloo.
When reaching the entry point of Charleroi airport (Whisky point), the engine coughed.
The pilot continued towards the airport, in order to land the aircraft as soon as possible, assuming the problem came from the engine.
When reaching the airport zone, the engine shut down.
The pilot then tried to reach the runway in a glide dive, but fell short in a construction area just outside the airport fences.

The aircraft rolled for 60m, and stopped against an embankment slope and the perimeter fence.

The pilot and the passenger exited the aircraft unharmed.

1. Factual Information

1.1. Chronology of the events

On 28 July 2007, the pilot of OO-PMS intended to perform a flight with a passenger for which it was his first flight.

The original plan was to fly from Charleroi (EBCI) to Middelburg, via Feluy and Afflighem. The return flight would be through Coa, Tielt, Afflighem and Feluy. The pilot computed a navigation of 188,5 nmi in a 2-hours flight.

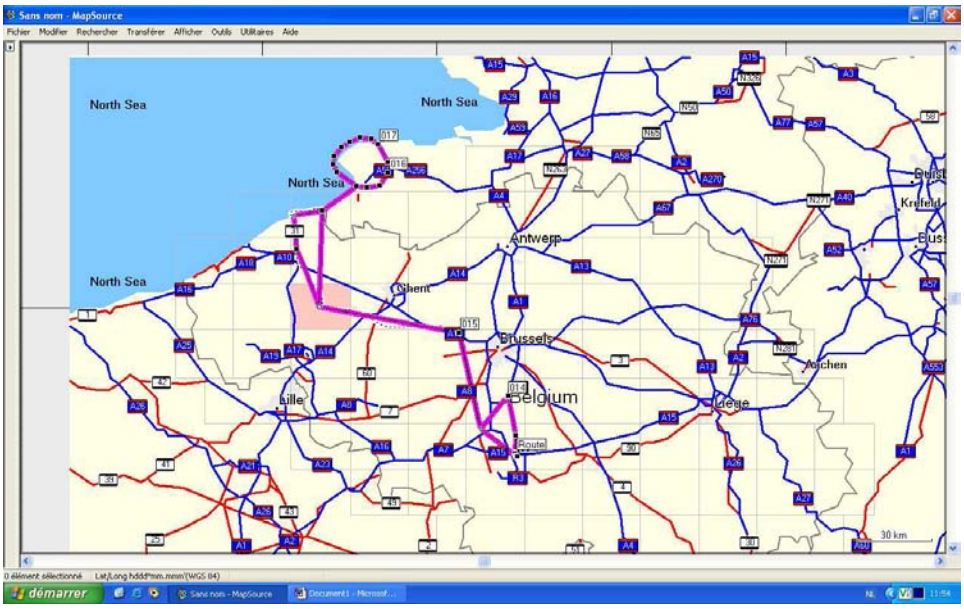
The planning was determined, using the AA-1B Flight Manual, and assuming an altitude of 1400 ft for most of the flight, and an engine rating of 2450rpm. The pilot computed an average fuel consumption of 5,6USG per hour, giving a potential flight time of 3h48min.

The pilot made the pre-flight check, and had to replace the battery. This caused a delay for the intended flight. The aircraft was then fuelled; both tanks were filled up.

The aircraft took off from EBCI around 14:45. The aircraft maintained the planned altitude, at a speed of 115 mph, fuel mixture selection on ‘rich’.

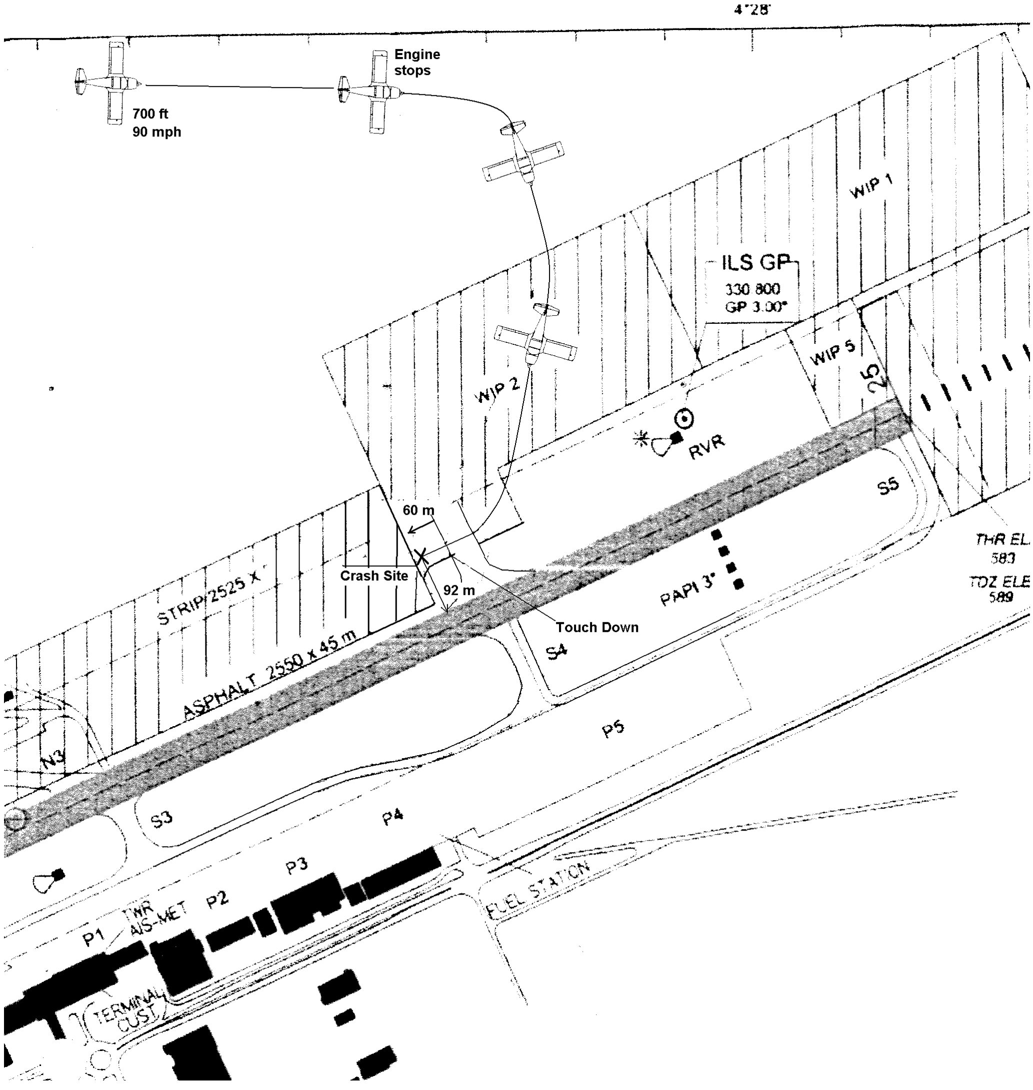
The flight went on initially as planned; above Middelburg, the pilot reduced the altitude to 800ft, and went around Walcheren island.

As per procedure, the pilot switched fuel tanks alternatively every 30min. in order to balance the wing tanks during flight.
The pilot stated the switching was not done with high precision, as he wanted to avoid switching tanks above populated area.



For the return flight, the pilot made a detour, and flew over Zeebrugge and Brugge before going towards Tielt and Afflighem. The aircraft went also around the Lion of Waterloo, before flying back to EBCI. The pilot was confident he had plenty of fuel in reserve for these small departures from the initial flight plan.

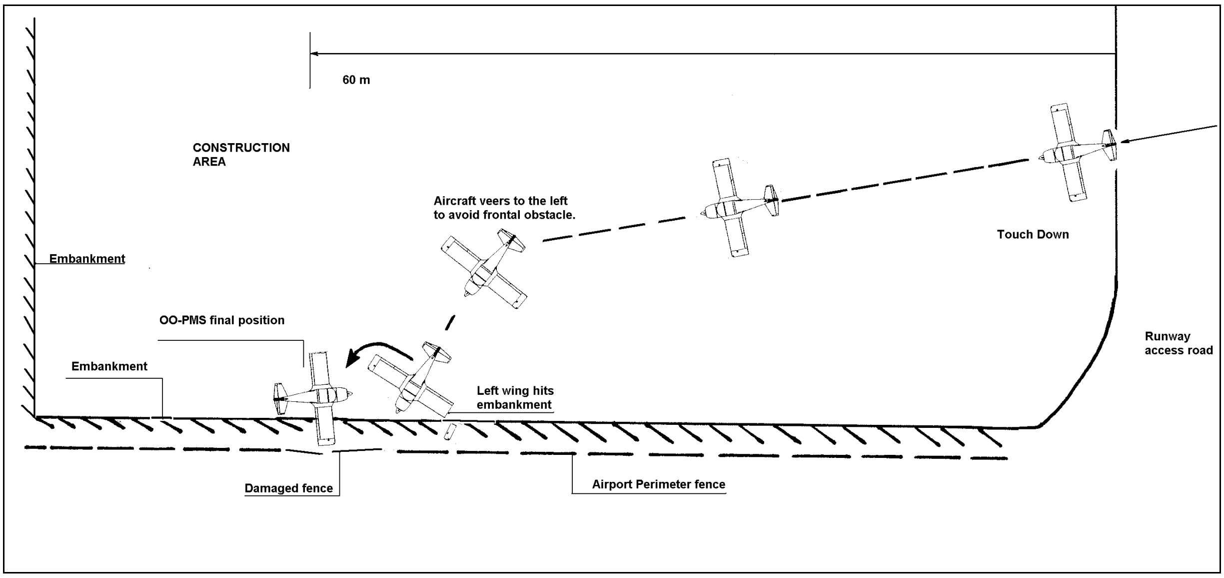
Before reaching the Whisky check-point (the water tower of Caterpillar on the N5 road Brussels-Charleroi), the pilot prepared for landing. At that time, the engine started coughing; the pilot changed the power rating, and the sputtering stopped. A few minutes later, above the Whisky check-point, the engine coughed again; the pilot switched off the fuel pump, and the problem seemed settled. During these events, the aircraft was losing altitude, in order to maintain speed; the altitude upon reaching EBCI airport was around 700ft.



The engine stopped when the aircraft reached the airport zone. The pilot wanted to land the aircraft as soon as possible, and directed the aircraft in a glide dive in the direction of the airport tower. The aircraft never reached the runway, and landed on a construction zone outside the perimeter of the airport. The aircraft touched the ground parallel to the runway, rolled for 60m, then veered towards the embankment slope bordering the airport perimeter.

When impacting the embankment, the left wing contacted the perimeter fence, and the aircraft rotated 180°,.
The aircraft stopped at 92m from the Runway 25.

The pilot and passenger exited the aircraft safely.



1.2. Injuries to persons

Injuries	Pilot	Passenger	Others	Total
Fatal	0	0	0	0
Serious	0	0	0	0
Minor	0	0	0	0
None	1	1	0	0
Total	1	1	0	2

1.3. Damage to aircraft

The left wing tip was severed from the wing. The left aileron was damaged. The cover of the right wing navigation lights was destroyed.

The underside of the wings was damaged. The upper surface showed local distortions.

The RH Horizontal Stabilizer was damaged.

The Rear spar of the RH Horizontal stabilizer was found cracked.

The state of the aircraft was assessed by the BCAA, and a report issued.

1.4. Other damage

The temporary "Heras" fence, at the perimeter of the airport was slightly damaged.

1.5. Personnel information

Pilot.
Sex: Male
Age: 25 years-old
Nationality: Belgian

Licence:	First issue 04 September 2006, expiring 04 September 2011. Class Rating: PPL – SE Piston (land). Limitations: none.
Medical:	class 1 General: Last 5/10/2006, expiring 5/10/2007. EC: Last 5/10/2006, expiring 5/10/2011. Audio: Last 5/10/2006, expiring 5/10/2011.

The pilot had a total of 129 Hrs experience, amongst which 48 Hrs Solo flights. In the last 15 days, the pilot had flown OO-PMS for 11 flight, with a total of 19Hrs.

The other aircraft types flown by the pilot included Beech 77, PA 28 and DRZ 160.

1.6. Aircraft information

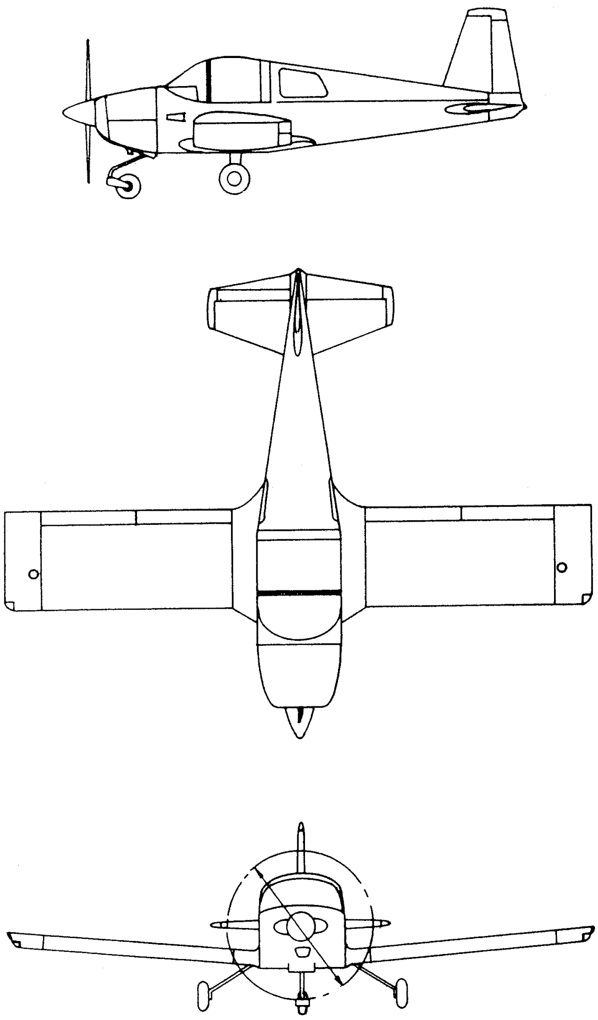
The Tiger Aircraft LLC (American General), ex Grumman American AA-1B is a two-place, all-metal, low-wing monoplane.
The landing gear is a non-retractable tricycle type.

The AA-1B trainer was certified initially on June 30, 1972 as a utility category airplane (Type Certificate A11EA Revision 10, May 12, 2000).

The Type Certificate reads: For normal operation, maintain fuel balance. Demonstrated fuel unbalance 7 Gal.

This aircraft has a limited capability for acrobatic manoeuvres, including chandelles, lazy eight, steep turns, stalls (except whip stalls). Spins are prohibited.

Performance Specifications:
Maximum Weight: 1560 lb
Fuel Capacity: 24 USG
Range: (Cruise, 75% Power at 8000ft, 22 USG, no reserve): 435 mi – 3,52hrs.
Landing ground roll: 410 ft.



AA-1B 3-side view.

Airframe
Manufacturer: Grumman American
Type: AA-1B Trainer
Serial Number: AA1B-0354
Built year: 1974
Registration: OO-PMS
Certificate of Registration: N°2446, issued 9 September 1999.
Certificate of Airworthiness: N°2446, first issue 8 July 1996, valid until 21 June 2008. Authorization for aerial work (first flights and training) and Private Aviation

Engine
Manufacturer: Lycoming
Type: O-235-L2C
Total Flight Hours: 5338 FH
The CofA includes the Certificat d'Homologation N°96-03, dated 05 August 1996 for the replacement of the original engine by the O-235-C2C; the replacement was done in accordance with STC Kennis G. Blackman (STC N° SA641NW)
The following remarks are added:

- The Lycoming O-235-L2C is not modified to increase the power up to 125CV.
- The 125CV engine placard is not used.
- The diagrams for power, consumption, … of the Lycoming O-235-L2C must be used.
- The Mc Cauley 1A105SCM7154 propeller must be used as is without modification of the pitch.

Propeller
Manufacturer: Mc Cauley
Type: 1A105SCM7154
Serial: G19242

Maintenance
Maintenance has been performed regularly, in accordance with manufacturer's instructions.

There was a technical defect reported on the aircraft before departure; the battery was discharged. The correction of the defect (charging of the battery) caused a delay on the intended departure time of the aircraft.

Owner
Air Rent Services
Route de Mons, 96
7390 Quaregnon

1.7. Meteorological information

Observed at Charleroi Airport

Wind:
Direction: 250°
Speed: 11kts

Visibility: more than 10 km.

Clouds:
Scattered at 4000ft

Pressure: 1018mb

Temperature: 20℃

The meteorological conditions had no influence on the accident.

1.8. Aids to Navigation

The aircraft was equipped with VOR and ADF.

1.9. Communication

The aircraft was in communication with the Charleroi Airport Tower. The pilot has reported the shutdown of the engine upon the occurrence.

1.10. Airport information

The aircraft had taken off and landed in the vicinity of Charleroi airport.

a. Geographical and administrative data

ARP COORD and site:	502736N - 0042710E 337° MAG / 205 m from the TWR
Direction and distance from (city)	4 NM N from Charleroi
ELEV / Reference temperature	614 ft / 22°C
Types of TFC permitted (IFR / VFR)	IFR / VFR

RWY designator	TRUE BRG	Dimensions of RWY (m)	THR COORD	THR ELEV and highest ELEV of TDZ of precision APCH RWY
07	065.47°	2550 x 45	502724.68N 0042633.01E	THR 611 ft TDZ 612 ft
25	245.47°	2 405 x 45	502752.82N 0042809.85E	THR 583 ft TDZ 589 ft

b. Routings.

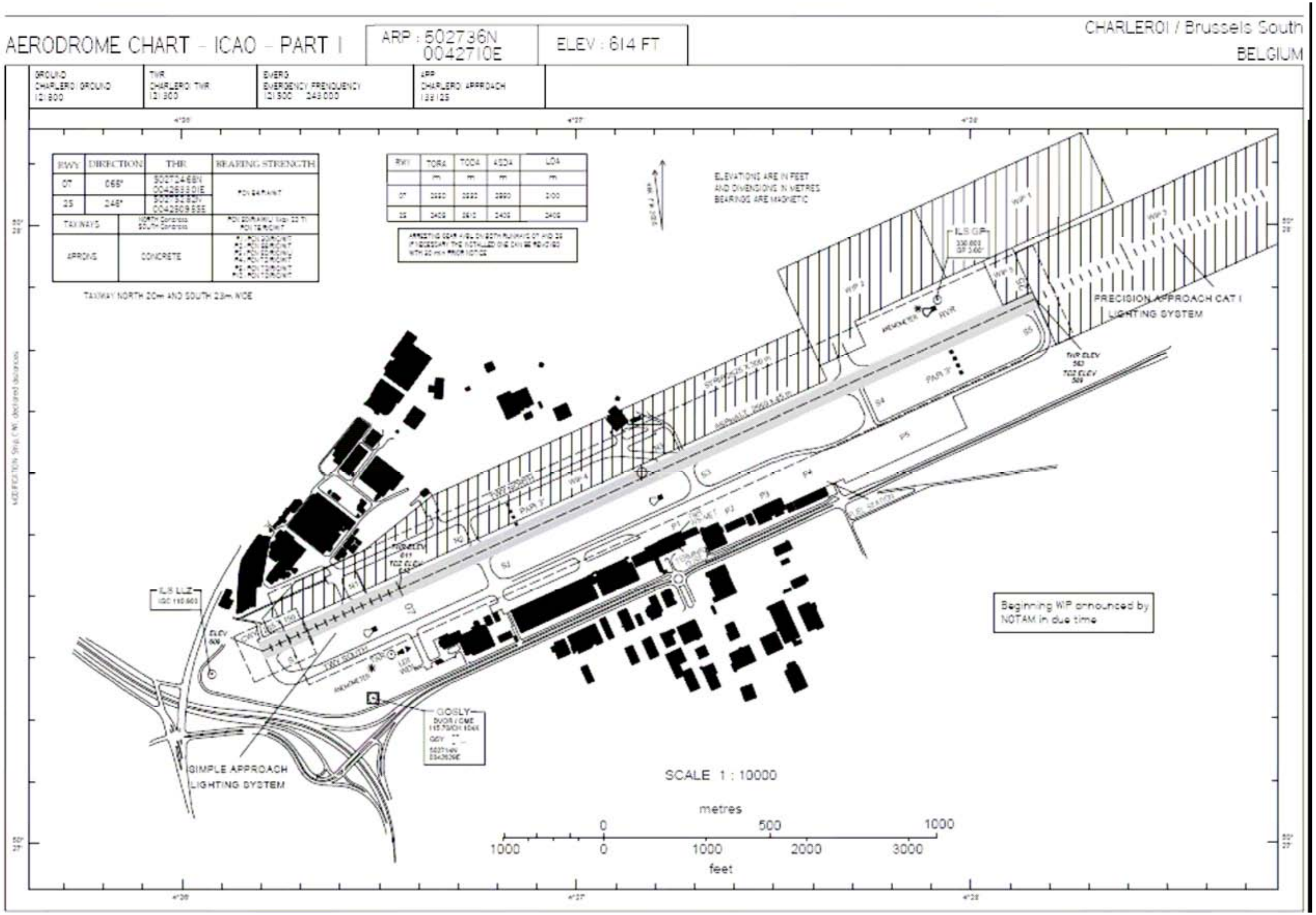
a. Unless otherwise instructed by Charleroi ATC ("Charleroi Tower"), the visual reporting points used for entering or leaving Charleroi CTR will be joined at 1 500 ft QNH MAX.

b. INBD TFC
   a. Routeing and visual reporting points

      Unless otherwise instructed, follow the road "Genappe - Charleroi" (N5) from visual reporting point VICTOR (Gas-tank CARGAS - 503218N - 0042708E) to visual reporting point WHISKEY (Water-tower - 502840N - 0042701E) and then left-hand downwind for RWY 07 or right-hand downwind for RWY 25.

   b. Radio communication

      Pilots shall report over each visual reporting point.


AERODROME CHART - ICAO - PART I
ARP : 502736N
0042710E
ELEV : 614 FT
CHARLEROI / Brussels South
BELGIUM
ELEVATIONS ARE IN FEET
AND DIMENSIONS IN METRES
BEARINGS ARE MAGNETIC
TAXIWAY NORTH 20m AND SOUTH 23m WIDE
PRECISION APPROACH CAT I
LIGHTING SYSTEM
SIMPLE APPROACH
LIGHTING SYSTEM
Beginning WIP announced by
NOTAM in due time
SCALE 1 : 10000
metres
0
500
1000
1000
0
1000
2000
3000
feet

1.11. Flight Recorders

Not applicable

1.12. Wreckage and Impact information

The aircraft touched the ground parallel to the runway, rolled for 60m, then veered towards the embankment slope bordering the airport perimeter.

When impacting the embankment, the aircraft rotated 180°, the left wing contacted the embankment and perimeter fence. The aircraft stopped at 92m from the Runway 25.

The terrain was reasonably hard and flat.

1.13. Medical and Pathological information

Not applicable.

1.14. Fire

Not applicable.

1.15. Survival Aspects

Both pilot and passengers had their safety belts on.

1.16. Test and Research

Engine test.
The day after the event, the engine was started with the fuel tank selector switch on the LH Fuel Tank.
The engine started normally.

Fuel quantities available.
The remaining fuel quantity on board was measured.

The quantities were:

Fuel Tank	Quantity
Left	7,3 USG
Right	0 USG

The wing showed no indication of fuel leak after the accident.

2. Analysis.

2.1. General.

The Grumman AA-1B has a high record of accident due to fuel starvation.

As a reference, the NTSB data show that on 147 recorded accidents since 1975 in the U.S.A, 26 were caused by fuel starvation.
This gives an average of 18% of the total.
The generic cause was:
"pilot's inadequate flight planning and en-route fuel consumption monitoring".

As a comparison, the accident database of a popular similar aircraft showed 192 similar cases of fuel starvation on a total of 2097 accidents, since 1984.
This gives an average of 9.2%.
A quicker review of accident data on other types of similar aircraft showed an average of 9-10 % cases of fuel starvation, which could be considered as an overall comparison standard.

2.1. Fuel Planning..

The Grumman AA-1B Flight manual covers 2 variants of the same model of aircraft; the "Trainer" and the "TR-2", the difference lays in the propeller type used:

For the "Trainer"; Mc Cauley Fixed Pitch (diameter/pitch): 71/53 (climb propeller)
For the "TR-2": Mc Cauley Fixed Pitch (diameter/pitch): 71/57. (cruise propeller)

OO-PMS is equipped with a Mc Cauley Fixed Pitch (diameter/pitch): 71/54

On the Type Certificate, the Propellers Mc Cauley 1A105 /SCM7154 and 1A105 /SCM7153 are handled together, and show the same limit.

The Flight Manual (Section II: Operating Instructions) states:
Cruise.
1. Auxiliary fuel pump: OFF
2. Power Setting: 2100 to 2600 rpm.
3. Mixture: Full rich when operating at more than 75% power. If in doubt as to percentage of power being used, use full rich mixture for all operations below 5000ft.
4. To maintain best fuel load balance, change fuel selector at approximately 30-minutes intervals during cruise. If flying solo, maintain the left tank about ½-tank lower than the right. This technique will substantially improve lateral trim

The flight manual shows two tables for the cruise and range performance, in order to determine the flight planning.

Each table specifies *"lean mixture"* and *"Note 1: Fuel consumption is for level flight with mixture leaned. See section III for proper leaning techniques. Continuous operations at power above 75% should be with full rich mixture".*

Item 3 above (If in doubt as to percentage of power being used, use full rich mixture for all operations below 5000ft.) leads to higher fuel consumption that the one identified in the table.
The presence of two different fuel consumption tables in the same Manual could lead to confusions.

The pilot used the correct table (indicated AA-1B Trainer), and computed a consumption of 5.6 USG per hour, but flying at 1400ft, he selected "Full Rich" in accordance with the Flight Manual's instruction. This led to an average fuel consumption during the flight of 6.14 USG per hour.

CRUISE & RANGE PERFORMANCE

AA-1B TR-2

* WITH CRUISE PROPELLER (STD.)

GROSS WEIGHT 1560 LBS.
STANDARD CONDITIONS
ZERO WIND
LEAN MIXTURE

ALTITUDE	RPM	PERCENT POWER	TRUE AIR SPEED	GALLONS/ HOUR	ENDURANCE HOURS	RANGE MILES
2500	2600	86	136	7.4	2.8	379
	2500	78	130	6.6	3.1	404
	2400	71	123	5.9	3.6	433
	2300	64	116	5.3	3.9	449
	2200	58	108	4.8	4.3	460
	2100	52	99	4.5	4.6	456
4500	2600	82	135	7.0	3.0	395
	2500	75	129	6.3	3.3	418
	2400	67	121	5.6	3.7	441
	2300	61	113	5.1	4.0	453
	2200	56	106	4.7	4.4	458
	2100	51	96	4.4	4.6	444
6500	2600	79	134	6.7	3.1	407
	2500	72	127	5.9	3.5	432
	2400	65	119	5.4	3.8	446
	2300	59	112	4.9	4.2	460
	2200	54	104	4.5	4.5	464
8500	2600	75	133	6.3	3.3	426
	2500	68	125	5.7	3.6	440
	2400	62	117	5.2	3.9	454
	2300	57	109	4.7	4.3	459
10,500	2600	72	130	5.9	3.5	435
	2500	66	122	5.4	3.8	447
	2400	60	114	5.0	4.1	455

NOTES:

1. Range and endurance data include allowance for take-off and climb.
2. Fuel consumption is for level flight with mixture leaned. See Section III for proper leaning technique. Continuous operations at powers above 75% should be with full rich mixture.
3. Speed performance is with wheel fairings. Subtract 2 MPH for speed performance without wheel fairings.
4. For temperatures other than standard, add or subtract 1% power for each 10° F. below or above standard temperature respectively.
* 5. Cruise propeller is standard on TR-2. For TR-2's equipped with optional climb propeller use Trainer data and add 2 MPH.

Figure 10

5–4

CRUISE & RANGE PERFORMANCE

AA-1B TRAINER

* WITH CLIMB PROPELLER (STD.)

GROSS WEIGHT 1560 LBS.
STANDARD CONDITIONS
ZERO WIND
LEAN MIXTURE

ALTITUDE	RPM	PERCENT POWER	TRUE AIR SPEED	GALLONS/ HOUR	ENDURANCE HOURS	RANGE MILES
2500	2600	77	125	6.5	3.2	400
	2500	70	118	5.8	3.6	420
	2400	64	112	5.3	3.9	437
	2300	59	106	4.9	4.2	445
	2200	54	100	4.7	4.5	444
	2100	52	95	4.5	4.6	441
4500	2600	74	124	6.2	3.3	410
	2500	68	117	5.6	3.7	428
	2400	62	110	5.1	4.0	438
	2300	57	105	4.8	4.3	444
	2200	54	100	4.6	4.4	442
	2100	52	97	4.5	4.5	437
6500	2600	71	122	5.9	3.5	419
	2500	65	116	5.4	3.8	431
	2400	60	109	5.0	4.0	439
	2300	57	104	4.8	4.3	443
	2200	54	100	4.6	4.4	439
8500	2600	68	120	5.7	3.6	428
	2500	63	114	5.3	3.9	437
	2400	59	108	4.9	4.1	442
	2300	57	104	4.8	4.2	438
10,500	2600	66	119	5.5	3.7	433
	2500	62	114	5.2	3.9	438
	2400	59	109	4.9	4.1	440

NOTES:

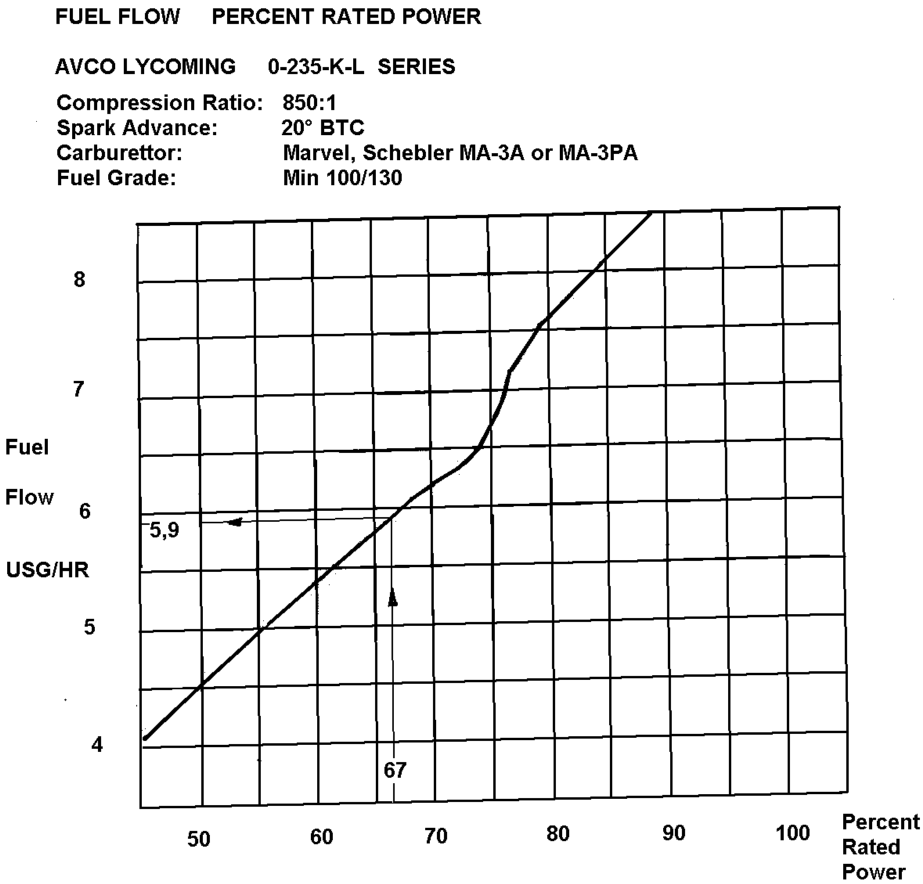
1. Range and endurance data include allowance for take-off and climb.
2. Fuel consumption is for level flight with mixture leaned. See Section III for proper leaning technique. Continuous operations at powers above 75% should be with full rich mixture.
3. Speed performance is without wheel fairings. Add 2 MPH for wheel fairings.
4. For temperatures other than standard, add or subtract 1% power for each 10° F. below or above standard temperature respectively.
* 5. Climb propeller is standard on Trainer. For Trainers equipped with optional cruise propeller use TR-2 data and subtract 2 MPH if not equipped with wheel fairings.

Figure 11

5–5

The Grumman charts are applicable to 0-235 C2C-powered AA-1B aircraft; OO-PMS is equipped with a 0-235 L2C engine.

The AVCO Lycoming operator's manual for 0-235 L series provides a fuel consumption chart – Figure 3-12 (Section 3, page 3-23); Fuel Flow vs Percent rated power.



If we combine the Grumman's and the Lycoming's chart, for an engine rating of 2450rpm – altitude 2500ft, the Grumman chart gives 67 percent power.

This information reported on the Lycoming chart gives ca 5,9 USG per hour.

If we compare the two charts using this rationale, we find that the consumption computed using the Lycoming chart, for the installed engine, is systematically higher than the one from the Grumman table.

To be able to use the Lycoming chart, OO-PMS needs to be equipped with a manifold pressure indicator, and a table giving from RPM and MaP, the rated Power.

2.2. In-Flight Fuel Management..

The tubular main wing spar is also a two-cell fuel tank. Each tank holds 12 USG, of which 11 are usable.

The 22 usable USG are selected by an OFF-LEFT-RIGHT selector.

Section II of the Flight Manual states:

To maintain best fuel load balance, change fuel selector at approximately 30-minutes intervals during cruise. If flying solo, maintain the left tank about ½-tank lower than the right. This technique will substantially improve lateral trim

The pilot stated he indeed performed the procedure with a reasonable accuracy, avoiding to switch tanks above populated area.

The pilot flew with this aircraft several times before; and when flying solo, as indicated above, fuel should be supplied first from the left tank.

When flying with a passenger, the initial selection (LH or RH) is indifferent.

If we perform the same calculations:

1. With the theoretical consumption of 5.55 USG (from the Cruise and Range Performance Chart), and starting the sequence with the LH Tank, we have the following (assumed flying time: 140 min.);

Time from Take-off	Switch position	Content LH Tank (USG)	Content RH Tank (USG)
0	LH Tank	11	11
30 min.	=>RH Tank	8,225	11
60 min.	=>LH Tank	8,225	8,225
90 min.	=>RH Tank	5,45	8,225
120 min.	=>LH Tank	5,45	5,45
140 min.	RH Tank *	3,23	5,45

"=>" means: switching to..

* In this configuration, the RH Tank is supposed to be the fullest tank upon landing. (Note: The pilot had selected the RH Tank upon landing, as per Flight Manual Section II; Landing instructions).

Anyway, in this configuration, the pilot had the impression there was plenty of fuel in both tanks.

2. If we take the average fuel consumption during the flight (6,14 USG per hour) and the same Switch selection sequence, we have the following:

Time from Take-off	Switch position	Content LH Tank (USG)	Content RH Tank (USG)
0	LH Tank	11	11
30 min.	=>RH Tank	7,93	11
60 min.	=>LH Tank	7,93	7,93
90 min.	=>RH Tank	4,86	7,93
120 min.	=>LH Tank	4,86	4,86
140 min.	RH Tank**	2,4	4,86

** Again, in this configuration, the RH Tank is supposed to be the fullest tank upon landing. (Note: The pilot had selected the RH Tank upon landing as per Flight Manual Section II; Landing instructions).

Using the theoretical chart figure, or the fuel consumption average does not give dramatic differences, none that would reflect the actual quantity of fuel found in the aircraft after landing.

These quantities were:

Fuel Tank	Quantity
Left	7,3 USG
Right	0 USG

As a theoretical hypothesis, these figures can be approached if we assume that 1 fuel tank selection was omitted, and that the sequence was started with the RH Tank:

Time from Take-off	Switch position	Content LH Tank (USG)	Content RH Tank (USG)
0	RH Tank	11	11
30 min.	RH Tank	11	7,93
60 min.	=> LH Tank	11	4,86
90 min.	=>RH Tank	7,93	4,86
120 min.	=>LH Tank	7,93	1,8
126 min.	=> RH Tank	7,3	1,8
140 min.	RH Tank	7,3	0

As there is no formal record of the fuel tank selection switching, it is impossible to determine the actual configuration, but we can state that the actual configuration does not match the originally planned one.

2.3. Fuel Indication..

Fuel quantity is indicated by two vertical sight gauges on the left and right cabin walls.

The gauges are accurate on the ground, but in flight their accuracy is reportedly unreliable.

To improve readability, FAA AD 78-13-04 mandated incorporation of Grumman American Service Bulletin 75-7. This bulletin introduced a colored marker in the tube.

Fuel gauges are notorious unreliable on many aircraft. On the Grumman AA-1B, there's an additional phenomenon; with one passenger on board, they are simply not visible.

View of the LH fuel gauge, from the pilot's position.

View towards the RH fuel gauge, with passenger on board, from the pilot's position.

2.4. Power setting.

The engine power setting on OO-PMS is done by using the RPM indicator essentially.

According to the cruise and range performance charts, the fuel consumption is depending very much on the Engine RPM. Maintenance programs do not require regular checks of the indicator's accuracy.

RPM indicators can show deviations in time, showing a lower RPM than actual. This could result in unnoticed higher fuel consumption.

2.5. Emergency Procedures.

Section 6 of the Grumman Flight Manual defines the emergency procedures; in particular:

Engine failure
Engine failures are very rare in modern aircraft. Should an engine failure occur, the basic procedures listed below may be a useful guide:

1. Establish best glide speed of 89 MPH for best range.
2. Check wind direction for landing.
3. Pick a suitable landing area and plan an approach.
4. Check fuel and switch the tank selector to the opposite tank if it contains fuel. Check fuel pressure and turn on electrical fuel pump if necessary.
   Mixture – Rich.
   Carburetor heat – ON
   Magneto's – Check right and left. If engine runs on either one, leave switch on that magneto.
5. If the engine does not start promptly, attention should be shifted to the forced landing procedure.
6. Notify ATC of your location and problem, if possible.
7. Fuel selector OFF; mixture to idle cut-off; turn ignition OFF; flaps as needed; and the master switch OFF.
8. Complete the landing and secure the aircraft. Notify ATC by telephone of your situation and location.

When faced with the engine shut down, the pilot executed this check list, (item 1 to 3), but his attention was immediately focused by the sink rate of the aircraft. This, coupled with the limited experience of the pilot, made that he did not perform completely item 4.

Owing to the history of fuel starvations in this type of aircraft, the sequence of actions could be improved, and the switching of the fuel tank and the electrical fuel pump should happen earlier.

3. Conclusions.

3.1. Findings

- The pilot had a valid Pilot's licence and medical certificate.
- The aircraft had a valid airworthiness certificate and was maintained in accordance with the manufacturer's maintenance program.
- No technical failure that would have caused the engine shut down was found on the aircraft.
- The LH Fuel Tank still contained 7,3 USG Fuel.

3.2. Causes.

The accident was caused by the conjunction of the following elements;

- The available fuel consumption chart of the Grumman Operator's manual does not provide an accurate computation of the expected fuel consumption.
- The actual flight time was longer than originally planned.
- The fuel management actually performed during flight diverged from the original intended planning (fuel tank selection sequence).
- The monitoring of the remaining fuel quantity in the two tanks is very difficult, or even impossible due to the fuel gauge configuration.
- The emergency procedure was not fully completed

4. Safety recommendations.

4.1. To BCAA / aircraft owner

To amend the OO-PMS Operator's Manual to replace the existing fuel consumption charts by one reflecting a more accurate fuel consumption, and taking into account the increased consumption when selecting the mixture 'full rich'.

4.2. To BCAA / aircraft owner / manufacturer

To amend the Flight Manual Section VI – Emergency Procedures in order to instruct the switching of the Fuel tanks earlier in the sequence of actions.

4.3. To BCAA / aircraft owner

To amend the maintenance program of OO-PMS and similar aircraft to have a regular test for accuracy of the engine RPM. A periodicity of one year would be adequate.

4.4. To BCAA / training school

In pilot's training, to use this event to highlight the importance of correct fuel management during flight.

Other interesting safety elements can be found in the FAA AC 20-105B: Reciprocating Engine Power-Loss Accident Prevention and Trend Monitoring.

4.5. To BCAA /EASA

Much of enquiries made on general aviation accidents are based upon witnesses and pilot's statements. This naturally leads to imprecision's and may eventually bias enquiries, as there is often nothing to contradict pilot's statements.
BCAA /EASA could evaluate the need to mandate the use of simplified Flight Data Recorders (on-board cameras, for example) for certain categories of general aviation aircraft.