AAIU Formal Report No.: 2002/013
AAIU File No. 2001/0067
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Name of Operator:	Limerick Flying Club Ltd
Manufacturer:	Socata
Model:	Rallye Commodore MS 892A-150
Registration:	EI-BCH
Nationality:	Irish
Location:	Ballycorney, Killaloe, Co. Clare, Ireland
Date and Time (UTC):	31 October 2001, 14.15 Hours

NOTIFICATION

ATC Shannon notified the Air Accident Investigation Unit (AAIU) of this accident at 14.28 hours on the 31 October 2001. An Inspector of Accidents of the AAIU arrived at Killaloe at 18.30 hours on the same evening and commenced the investigation.

On 2 November 2001, the AAIU transmitted formal notification of this accident to the French Bureau Enquêts-Accidents (BEA) and the Irish Aviation Authority (IAA).

Under the provisions of ICAO, Annex 13, (Aircraft Accident and Incident Investigation), the Chief Inspector of Accidents, Mr. Kevin Humphreys appointed Mr. John Hughes, Inspector of Accidents, to carry out an investigation into the circumstances of this accident and to prepare a Report for publication.

SYNOPSIS

The aircraft took off from Coonagh Airfield at 13.30 hours. The pilot had his father and young son on board as passengers and this was planned to be a sightseeing flight. The intended flight was outside controlled airspace and no flight plan had been filed with Shannon ATC. The pilot intended to fly NE across country along the east side of Lough Derg on the river Shannon as far as Garrykennedy and to return to Coonagh. Whilst over Killaloe in a descent inbound for Coonagh, the engine spluttered, the RPM decayed and after the propeller wind-milling for some time, it stopped rotating. The pilot then picked out a landing field, turned through 270º and commenced his forced landing. As the aircraft flared the belly of the fuselage caught a boulder in the field's perimeter hedge and the aircraft came to rest close to the hedge. All the occupants exited the aircraft unaided. There was no fire.

1 FACTUAL INFORMATION

1.1 History of the Flight

Coonagh Airfield is situated 2 nm west of Limerick city and is the home base of the Operator. When the pilot took over the aircraft he checked the spring loaded wing tank fuel drains for any water contamination of the fuel. He also checked the drain on the fuselage collector tank. There was no evidence of fuel leakage from the drains. He reported that the aircraft fuel gauge read 84 litres of fuel on board.

The engine was started at 13.05 hours (tachometer reading 85.93) and the aircraft was positioned on RWY 28 for an initial solo circuit. The pilot subsequently landed the aircraft at 13.13 hours (tachometer reading 86.02). The pilot said that he again checked the fuel gauge and that it was reading 80 litres. He chose not to refuel for a 1-hour flight. The two passengers embarked and were briefed and secured. The aircraft took off from Runway10/28 at 13.30 hours.

The pilot had his father and young son on board as passengers and this was planned to be a sightseeing flight. The father occupied the rear seat. The aircraft departed at 13.30 hours local. The intended flight was outside controlled airspace and no flight plan had been filed with Shannon ATC. The aircraft levelled off at 900ft with the engine set at 2200 RPM. Abeam Killaloe the aircraft climbed to 1500 ft. The pilot flew NE across country along the east side of Lough Derg as far as Garrykennedy, a distance of 23.5 nm, and then decided to return to Coonagh.

On the return leg, abeam Killaloe at 1500 ft above sea level, the pilot reported that the fuel sight gauge showed the fuel level to be slightly more than 60 litres. This amount was transmitted to another pilot on the ground who was to take over the aircraft on termination of the flight. The pilot carried out FREDA checks (fuel, radio, engine, DI sync, altimeters) and had nothing significant to report.

At 1100 ft ASL in a descent inbound for Coonagh, between Killaloe and O'Briensbridge, the engine spluttered, the RPM decayed and after the propeller wind-milled for some time, it stopped rotating. The fuel gauge was rechecked and indicated 60 litres approximately. The pilot then picked out a landing field, turned through 270º, and commenced his approach. As the aircraft flared the belly of the fuselage caught a boulder in the perimeter hedge and the aircraft came to rest close to the hedge. All the occupants exited the aircraft unaided. The reported time of the accident was 14.15 hours local.

The rear seat occupant, who sustained a nosebleed, walked to the roadway and made contact with a locally resident Shannon Airport staff member who contacted the Airport duty officer and ATC.

1.1.1 Witness Statements

A witness, who was also a member of the aero club arrived at the scene shortly after the forced landing, said that when he viewed the fuel sight gauge the ball, which would normally indicate the level of fuel in the aircraft, indicated 60 litres. The witness said there was no indication of fuel leakage from the aircraft.

When the AAIU investigator arrived some hours later, this ball was not visible and had dropped down to the base of the tube. There were no indications of fuel leaks from the aircraft

An instructor, who flew in the aircraft for the last flight of the 29 October 2001, said that the fuel gauge registered 40 litres when he took over the aircraft. This was also the last flight before the accident flight on the 30 October 2001 and was of 40 minutes duration.

1.1.2 Flight Log

On 27 October 2001, 71 litres of fuel were added and the sight gauge registered 130 litres of fuel on board prior to take off. The following day another 50 litres of fuel were added and on the 29 October 2001 a further quantity of 60 litres was added. The total flight time covered with this quantity of 240 litres to the time of the accident was 9 hours and 20 minutes. The engine tachometer recorded 7.04 hours during this time. (These figures give a fuel consumption of 25 l/hr using flight time and 34 l/hr using engine tachometer time.)

Prior to the last flight of the 29 October, when 40 litres on board was recorded, the total flight time covered with 200 litres of fuel was 7.55 hours. The engine tachometer recorded 5.9 hours during this time. (These figures give a fuel consumption of 25 l/hr using flight time and 33.8 l/hr using engine tachometer time and serve to confirm the accuracy of the above fuel consumption figures.)

1.2 Injuries to Persons

Injuries	Crew	Passengers	Others
Fatal	None	None	None
Serious	None	None	None
Minor	None	One*	None

* The rear-seat passenger suffered a cut nose

1.3 Damage to Aircraft

The nose undercarriage was ripped from the aircraft. The main undercarriage legs were pushed back so that the wheels made contact with the flaps, which were found in the retracted position.

The aircraft was dismantled in the field. During dismantling all fuel lines to the collector tank were checked for security and absence of leaks. No leaks were found. In order to remove controls the port fuel line to the collector had to be cut. No fuel was found in the line. The aircraft was removed to the aero club premises.

1.4 Other Damage

There was no other damage.

1.5 Personnel Information

***Commander**:*

License:	PPL (UK)
Periodic Check (PC):	17 July 2001
Instrument Rating:	Nil
Medical certificate:	Class 1, (24 September 2001)

Flying experience:

Total flying:	141 hours, 30 minutes
Total on Type:	5 hours, 48 minutes
Last 90 days:	4 hours, 12 minutes
Last 28 days:	2 hours, 36 minutes
Last 24 hours:	12 minutes

1.6 Aircraft Information

1.6.1 General

The MS 892A Rallye Commodore 150 is a four-seat version of the Socata Rallye with larger rudder, ailerons and strengthened structure for increased AUW. It is fitted with a 150 HP Lycoming engine and has a longer nose-wheel leg to give increased propeller clearance.

1.6.2 Leading Particulars

Registration:	EI-BCH
Manufacturer:	Socata
Date of Manufacture	1965
Model:	Rallye Commodore MS 892A-150
Serial No:	10561
Engines:	One Lycoming 0-320-E2A
Propellers:	One Twin Blade Sensenich 74DM6-O-54 S/N 27067
Certificate of Registration:	Valid, issued by the IAA on 18 April 2000.
Certificate of Airworthiness:	Valid, Issued by the IAA on 14 August 2001.

Aircraft Mass and Balance:	M.A.W	980 kg. (2160 lbs),
	C of G limits:	30.76 ins to 41.15 ins.
	Estimated T.O. weight	803 kg (1770 lbs)
	C of G at T.O.	36 ins
Fuel:	Useable Fuel	178 ltr
	Consumption	30 ltr/hr @ 2400 rpm
		27 ltr/hr @ 2300 rpm

1.6.3 Aircraft Maintenance

During an annual inspection in May 1999, an outside contractor installed a replacement engine in EI-BCH. The factory-overhauled engine had a total time since new of 4780 hours. The airframe had 2624 hours accumulated at that stage and had not flown since the previous May. All flexible fuel pressure hoses were replaced at that time. The C of A test flight was conducted on 16 June 1999. The aircraft flew on a continuous basis until 7 February 2001.

At that time a different maintenance contractor carried out an Annual Inspection on the aircraft, in accordance with LAMS/A/1999 Issue 1, at a total airframe hours of 2885 hours. The logbook insertion included the following:

Engine compression check carried out in accordance with S.I. 1191A.
Baffles repaired on front starboard side. Complete exhaust removed, gaskets and all hardware renewed due to poor sealing. Induction down pipes removed, rubber hoses and cylinder gaskets renewed. Engine cylinder barrels touched up with Lycoming grey paint as required.

Port wing replaced due to spar exfolication corrosion, serviceable wing fitted, ex. Aircraft EI-BFM Type: MS893E S/N 12958. Existing controls refitted, rigged and set to manufacturers recommendations. Tail section was removed to satisfy corrosion Service Bulletin 133/2.
(AD 32- 89). All attachment brackets cleaned, zinc chromated and re-fitted. Duplicate Inspection carried out for aileron, flap, slat, elevator, and rudder control disturbance.

The replaced wing was, in fact, the starboard wing. The aircraft was signed out on 14 August 2001 and test flown two days later. A 50-hour check was carried out on 5 September 2001 and a final 50-hour check carried out on 10 October 2001, at 2985 airframe hours. At the time of the accident the airframe logbook recorded 3016 hours and the engine logbook, 391 hours since factory reconditioned.

1.6.4 Aircraft Systems

On the MS 892A-150 aircraft the fuel is contained in two metal tanks located in the wing compartment. The fuel is fed from these tanks into a lenticulor tank fitted to the cabin floor. An illustration of the fuel system is shown at Appendix A.

A vent line connects the top of the fuel quantity sight tube with each tank vent. This line is then vented to atmosphere through the cabin floor. A check valve at each tank allows the tank to breathe.

On the MS 893 E aircraft each tank is connected to a 3 way, 3-position (left-closed-right) cock. An illustration of its fuel system is shown at Appendix B. A pipe, passing through the firewall, feeds the fuel from the cock to the electrical booster pump and filter to the engine-driven pump. Each tank is fitted with 2 float-type transmitters, which allow the available fuel quantity to be known at all times. Fuel content indicators (1- 2) are located on the centre of the instrument panel strip. Each tank is provided with a filling neck (3), a bleed and drain cock (4) located on the wing lower surface, and a venting device consisting of a tube fitted with a check-valve (5) opening on the wing lower surface. A cock (6) located between each tank and the fuel shut-off cock (7) is accessible from under the fuselage.

The starboard wing of EI-BCH and EI-BFM are similar but not the same. They differ mainly in the fuel quantity measuring system used and fuel venting.

The flight manual for EI-BCH (MS 892A) states that the usable fuel contents is 178 Litres

1.7 Meteorological Information

	Forecast conditions* (www.met.off.gov.uk)	**Actual conditions**
Wind Direction and Speed:	290/10 kt	300/10 kt
Visibility:	10 km +	10 km +
Significant Weather:	No sig	No sig
Cloud:	Sct 2500	Sct 2500

* obtained by the pilot prior to flight.

1.8 Aids to Navigation

Not a factor.

1.9 Communications

Not a factor.

1.10 Aerodrome Information

Not a factor

1.11 Flight Recorders

There were no recorders fitted nor were these required.

1.12 Wreckage and Impact Information

The wreckage, which was facing opposite to the direction of the aircraft's approach, was contained within an area of 10 metres radius from the perimeter boulder, which was struck during the flare. The nose undercarriage was ripped from the aircraft and found 5 metres in front and to the right of the aircraft's nose. Damage to the field was considered minor.

1.13 Medical and pathological information

Not applicable.

1.14 Fire

There was no fire.

1.15 Survival Aspects

The pilot and front passenger used the full four-point shoulder harness provided and the rear passenger a two-point lap harness only.

1.16 Tests and Research

With the wings removed, the collector tank was filled with fuel and a variable head of fuel allowed to move the small sight ball of the fuel gauge up and down in the transparent tube. It was noticed that the ball would not at all times respond to the fuel level and that the fuel meniscus would drop away from the ball. This was particularly so between readings of 60 litres and 80 litres. As the sight gauge was discoloured with age, it was not always possible to observe the meniscus. Also the position of the gauge to the lower left of the pilots seat would make it very difficult to continually observe this gauge in flight.

1.17 Organizational and Management Information

Following the accident the investigation learned that some club pilots were aware that, on occasions, the sight gauge of this aircraft could give erroneous readings. This information had been promulgated verbally within the club to some of its members. There was no evidence that this had ever been noted as a defect in the flight log.

1.18 Additional Information

The Light Aircraft Maintenance Schedule CAA/LAMS/A/1999 requires that prior to the first flight of the day that the pilot should *"Check visually that quantities of fuel are compatible with indicator readings."*

The pilot of this aircraft said that he attempted to do this on the day of the flight in question but, because of the high wing dihedral angle (12.5º), it was difficult to accurately verify the fuel contents during the pre-flight inspection.

The aircraft Maintenance Manual requires the *"checking of the correct operation of the fuel gauges"* every 100 hours of flight.

The plastic tube of the sight gauge is prone to harden and discolour with age. The Investigation found that there is no CAA or manufacturers instruction or advisory about replacing this gauge from time to time during the life of the aircraft. On the later MS 892 and MS 893 aircraft float type fuel level transmitters in conjunction with instrument panel mounted electrical indicators were installed. These are much more reliable and negate the presence of fuel in the cabin as in the case of EI-BCH.

2 ANALYSIS

There was a reported 40 ltr of fuel registered on board the aircraft prior to the penultimate flight which took place on 29 October 2001. No further fuel was added and that flight lasted 40 minutes. The accident flight took 45 minutes. Thus these two flights took 1 hr 25 minutes. Taking the Flight Manual figure for fuel consumption of 30 ltr/hr at 2400 RPM, 40 ltr of fuel would have been consumed in 1 hr 20 minutes. This indicates that the instructor's figure of 40 ltr of fuel on board, prior to his flight, was reasonably accurate. There would therefore have been only 20 ltr of fuel on board when the pilot took off for the solo flight on 30 October 2001. This solo flight lasted 8 minutes and would have taken in the region of 4 ltr, leaving only 16 ltr of fuel on board.

The pilot reported that he had 84 ltr of fuel prior to the solo flight and 80 ltr prior to the accident flight. This difference agrees with the amount of fuel, which would be expected to be consumed during the solo flight. The 60 ltr of fuel recorded during the return flight is also in the region of what would be expected at that stage of the flight.

It is clear that the sight gauge was faulty particularly between the 60ltr and 80 ltr marks and from tests carried out, that this was due to the ball sticking in the gauge. It cannot be ascertained how the ball got from reading 40 ltr at the commencement of the penultimate flight to reading 84 ltr at the start of the accident flight without aircraft refuelling. It is possible that during the flight of the previous day fuel was forced up the sight gauge during a banked manoeuvre, aerobatics or heavy landing and that the ball stuck in the tube as the aircraft levelled. However this would not explain how the ball subsequently dropped from reading 84 to 80 to 60 litres just prior to the forced landing.

The only sure way to check the correct operation of the fuel gauge on an inspection is to check the reading at regular intervals during a defuelling/refuelling operation. It was stated that some pilots were aware that, on occasions, the sight gauge could give incorrect readings. Clearly, this defect should have been rectified during maintenance.

If the LAMS requirement for a fuel contents/ indicator compatibility check cannot be carried out prior to the first flight of the day, then there must be a requirement to fill the tanks to full prior to the first flight of the day so that this compatibility check can be made. If this is not possible due to such considerations as aircraft AUW and runway length then a procedure should be in force whereby the fuel fillings book and the flight log are reviewed by the pilot in order to establish the "fuel remaining". All other considerations apart, a general rule should require that fuel should be added if the contents are less than 50% full.

The pilot did well in executing the forced landing, considering his overall flying experience, and was unfortunate to strike the boulder during the landing flare. However, his lack of experience on type was evident in his failure to adequately verify actual fuel contents against the indicator reading prior to the first flight of the day.

The installation of a starboard wing from EI-BFM on this aircraft changed the original design of the aircraft fuel venting system. However, this was not a contributory factor to this accident.

3 CONCLUSIONS

3.1 The fuel contents gauge was faulty. There was only in the region of 20 litres of fuel on board when the fuel contents sight gauge registered 80 litres.

3.2 The pilot was unable to visually check the compatibility of the fuel indicator readings with the amount of fuel in the tanks.

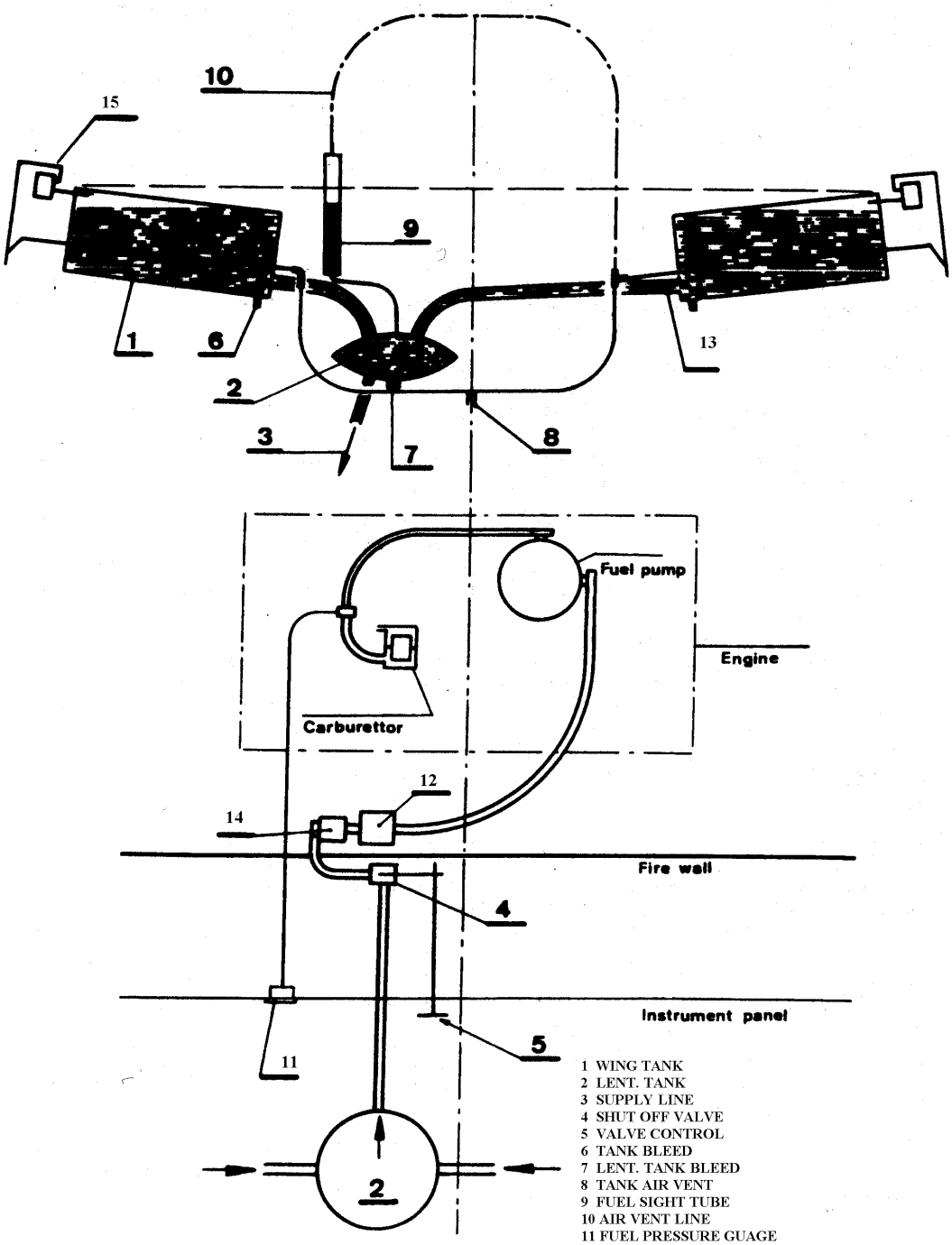
3.3 The engine was starved of fuel causing a complete loss of power and compelling the pilot to carry out an immediate forced landing, from which the three occupants of the aircraft walked away without any injury to their persons.

4. RECOMMENDATIONS

4.1 The manufacturers of the aircraft should introduce an Instruction or Service Bulletin in order to replace the plastic tube of the fuel sight gauge with new tubes at regular calendar intervals. **(SR 27 of 2002)**

4.2 The Flying Club should review its fuelling policy in order to comply with the terms of LAMS/A/1999 Section7 (A5) for aircraft which do not have a visual method of verifying fuel indicator readings with actual fuel contents. **(SR 28 of 2002)**

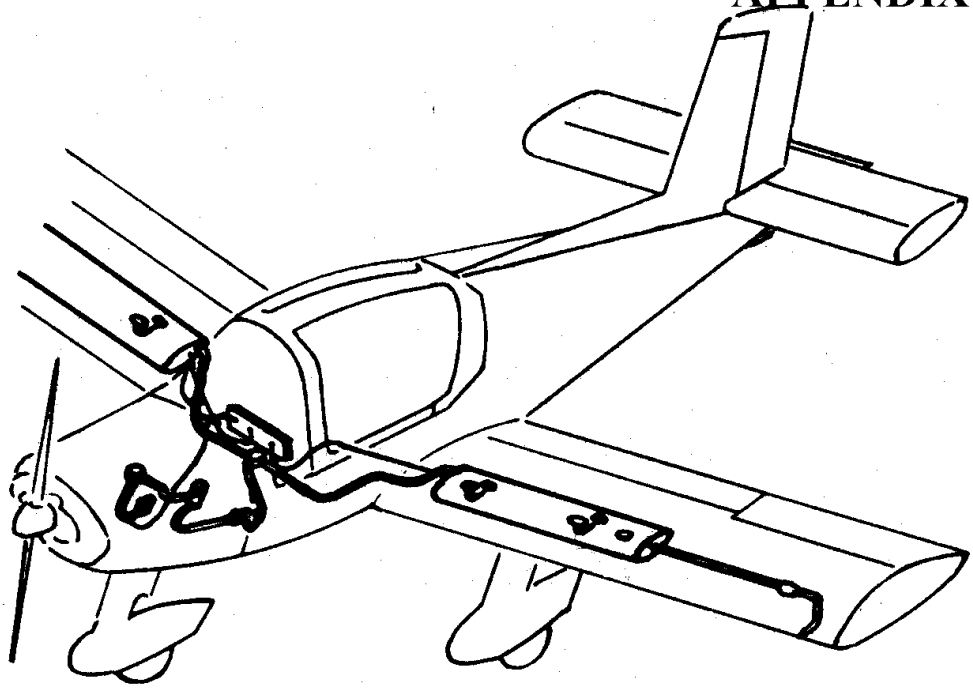
APPENDIX A

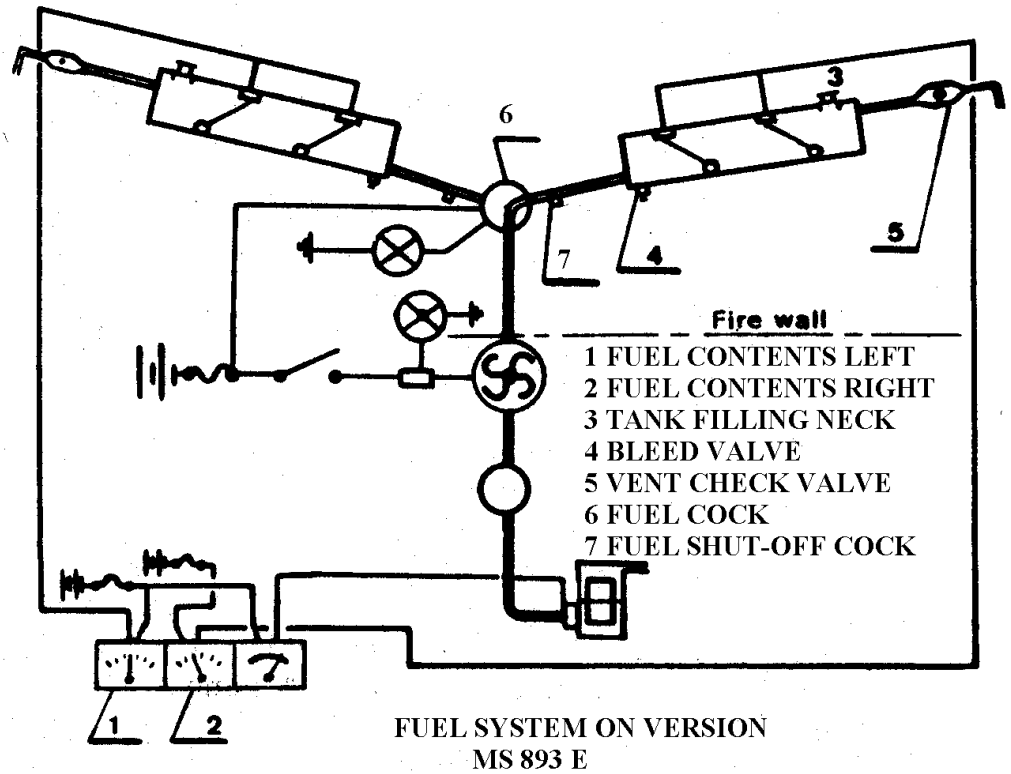


1 WING TANK
2 LENT. TANK
3 SUPPLY LINE
4 SHUT OFF VALVE
5 VALVE CONTROL
6 TANK BLEED
7 LENT. TANK BLEED
8 TANK AIR VENT
9 FUEL SIGHT TUBE
10 AIR VENT LINE
11 FUEL PRESSURE GUAGE
12 BOOSTER PUMP
13 TANK OUTLET FILTER
14 FUEL FILTER
15 CHECK VALVE

FUEL SYSTEM
VERSION 892A

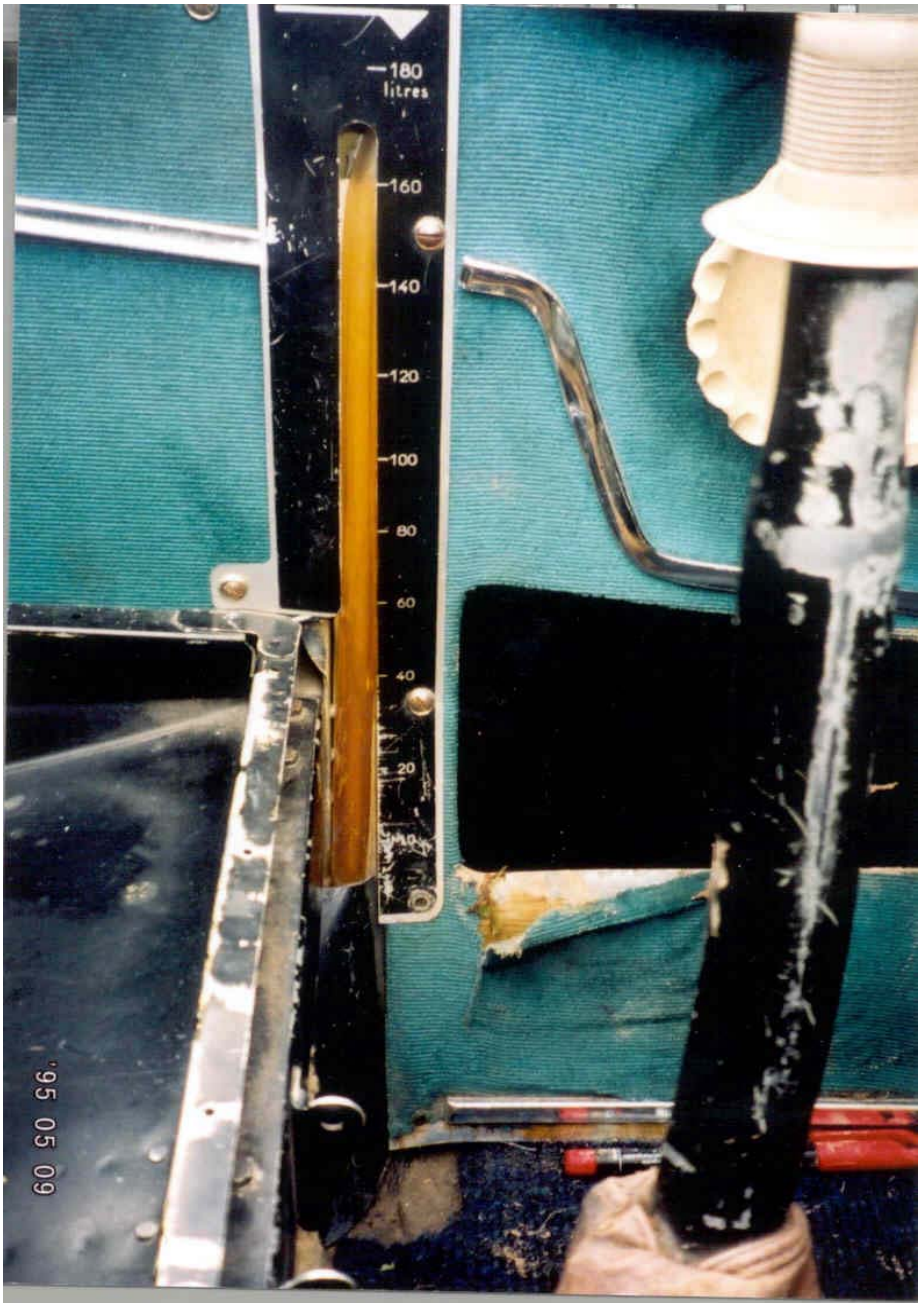
APPENDIX B





FUEL SYSTEM ON VERSION
MS 893 E

APPENDIX C



Empty fuel contents gauge, located on cockpit wall, pilot's side,

following the forced landing at Ballycorney.