

ACCIDENT

Aircraft Type and Registration:	Hughes 369HS (Hughes 500), G-LINC	
No & Type of Engines:	1 Allison 250-C18A turboshaft engine	
Year of Manufacture:	1973	
Date & Time (UTC):	2 January 2006 at 1530 hrs	
Location:	Sywell Aerodrome, Northants	
Type of Flight:	Private	
Persons on Board:	Crew - 1	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Tail boom separated and landing skids splayed	
Commander's Licence:	Private Pilot's Licence	
Commander's Age:	60 years	
Commander's Flying Experience:	263 hours (of which 60 were on type) Last 90 days - 5 hours Last 28 days - 5 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot and further enquiries by the AAIB	

Synopsis

The helicopter's engine flamed out whilst it was on final approach to land at Sywell Aerodrome. The pilot established autorotation but upon landing, the helicopter's tail boom was struck by the main rotor and the skids were splayed by a heavy landing. The helicopter had run out of fuel.

History of the flight

The pilot reports that he did not physically check that the fuel tank was full, but it was indicating FULL at start up. The refueller of the helicopter reports that he filled it up "to the brim" after its preceding flight a few days before.

Initially, the pilot flew 16 nm from Sywell to Catthorpe, near Rugby in Warwickshire, in order to pick up his passenger. After landing, the pilot kept the engine running while his passenger boarded. They then flew to Folkestone Race Course (113 nm point-to-point) where they spent the day. The helicopter was not refuelled at Folkestone because no fuel was available.

The flight back to Sywell was uneventful until just north of Luton Airport. At this point the FUEL LOW caution light flickered once or twice. The pilot was not concerned as this had occurred to him before with a low fuel state. He attributed the flickering caption to the fuel moving around in the tank as a result of air turbulence. Prior to this, the pilot had not made a fuel burn check while en route.

At approximately 10 nm from Sywell the FUEL LOW caution light came on permanently. He was not too worried by this because his GPS indicated he was 6 mins from Sywell. He believed that when the FUEL LOW caution light came on, he still had 15 mins flying time available.

Due to a number of microlight aircraft in the circuit at Sywell, the pilot elected to join the circuit at the end of the downwind leg rather than fly a straight-in approach. Whilst on final approach, at 400 ft agl, the engine flamed out. The pilot commenced an autorotation and landed firmly short of the threshold of Runway 23. He did not recall what his cyclic control inputs were during the touchdown. The pilot and his passenger vacated the helicopter uninjured.

Sywell Aerodrome is normally a licensed airfield. On the day of the accident, a Bank Holiday, the aerodrome was closed and so it was unlicensed; consequently, the fire tender was not available. However, a member of the fire crew was on the airfield at the time of the accident. Upon seeing the accident he ran over to the helicopter with a fire extinguisher and checked that the helicopter was made safe as the occupants vacated the helicopter.

Weather

The weather in the Sywell area was generally fine but cool with light and variable surface winds; there was no cloud below 2,000 ft altitude. The wind at cruising altitude was variable over Kent but north-westerly at 10 kt in the West Midlands area. This gave an average headwind component of about 5 kt for the return journey.

Pilot's fuel planning

The pilot reported that he used a fuel burn estimation of 150 lb/hr in the cruise and has found this to work on

previous flights in this helicopter. He did not add an allowance for start up, taxi and takeoff.

The helicopter left Sywell with a full tank of 435 lb of AVTUR fuel. Prior to the accident flight the pilot flew for 6 mins from Sywell to Catthorpe, before flying a further 1 hr 10 mins to Folkestone.

Before departing Folkestone for Sywell, the pilot made the following calculations.

Indicated fuel on board	200 lb
Distance from Folkestone to Sywell	99 nm
Pilot's own fuel burn figure	150 lb/hr
Flight time at 110 kt cruise	54 mins
Flight time factored for headwind component of 5 kt	57 mins
Fuel burn	143 lb
Fuel in reserve	57 lb

The total planned flight time for the day would have been 2 hours 13 minutes. The owner of the helicopter added that he always plans to fly for a maximum of 2 hours without refuelling.

Fuel planning advice

An extract from Safety Sense leaflet 17, *Helicopter Airmanship* is shown below.

3.9 Fuel Planning

a. Always plan to land by the time the tank(s) are down to the greater of 1/4 tank or 45 minutes, but don't rely solely on the gauge(s) or low fuel warning. Remember, a headwind may be stronger than forecast, which particularly affects slower flying helicopters. Frequent use of carb heat/ hot air will also increase fuel consumption.

b. Know the hourly fuel consumption of your helicopter. In flight, check that the gauge(s) agree with your calculations.

c. Understand the operation and limitations of the fuel system, gauges, pumps, mixture control (do not lean mixture unless it is permitted), unusable fuel etc.

Helicopter manufacturer's information

Fuel gauge accuracy

The volumetric capacity of the fuel tank is 242 ltr of which 2 ltr is unusable. Depending on the fuel type, the weight of fuel in a full tank varies between 435 lb and 416 lb. Loading Jet A fuel results in a total fuel weight of 435 lb.

The fuel gauge uses a float resistance measuring system. The gauge is marked in increments of 100 lb and the full capacity marked on it is 420 lb. The accuracy of the fuel gauge markings and the low-level light are tested by putting fuel in the tank and measuring or adjusting as necessary to meet the Handbook of Maintenance Instructions specifications.

Fuel planning figures

There is no quoted fuel burn figure to be used for planning purposes or to account for the fuel used during start up, taxi and takeoff. The aircraft manufacturer advised that for planning purposes, 435 lb of fuel is sufficient for 1 hr 48 mins of flight time. A figure of 30 to 40 lb of fuel would be a reasonable allowance for start up, taxi and takeoff. Fuel consumption on a standard day (sea level/15°C) can vary from 150 to 220 lb/hr depending on conditions, flight profile, engine performance, etc.

The amount of unusable fuel quoted in the Flight Manual is 4.9 lb. After the accident, the fuel tank of helicopter G-LINC was drained of residual fuel and 4.5 lb were recovered.

Information obtained from a commercial operator

A commercial operator of the Hughes 369 reports that the company use an allowance of 30 lb for start up, taxi and takeoff. Thereafter the company uses a 'trip fuel'¹ consumption rate of 200 lb/hr for flight planning purposes (their helicopters have a different engine type to G-LINC and a slightly higher consumption rate). The company also makes appropriate allowances for reserve fuel, contingency fuel and unusable fuel when calculating the fuel required for a revenue flight.

The pilot expected to have 57 lb of fuel in reserve on arrival at Sywell. If 30 lb is subtracted to allow for start up, taxi and takeoff, this leaves 27 lb in reserve, of which 5 lb is unusable, leaving 22 lb of usable fuel before engine flame-out. Optimistically, this equates to 8 mins 48 sec of flying time at 150 lb/hr before fuel exhaustion.

Helicopter Flight Manual

An extract from the helicopter's Flight Manual is shown below stating the action to be taken when a FUEL LOW caption illuminates.

FUEL LOW

Indications: Yellow FUEL LOW indicator ON when approximately 35 pounds of fuel remains in fuel tank.

Procedures:

- *Avoid large steady side slip angles and uncoordinated manoeuvres.*

CAUTION- Never use the FUEL LOW light as a working indication of fuel quantity.

- *Land as soon as possible.*

Footnote

¹ Trip fuel consumption is a coarse estimate of fuel consumption per hour that takes account of fuel used during all airborne flight phases (takeoff, climb, cruise, descent, approach and landing).

WARNING Fuel consumption rates vary with power demand. Pilots should land prior to fuel exhaustion. Fuel exhaustion will result in engine flameout.

The Flight Manual's definition of 'Land as soon as possible' was:

Execute a power-on approach and landing to the nearest safe landing area that does not further jeopardize the aircraft or occupants.

Conclusion

The helicopter's skids splayed as a result of a heavy landing. The tail boom was 'chopped off' by the main rotor; this was probably a result of moving the cyclic rearwards in a bid to cushion the heavy, autorotative landing, causing the rotor disc to tilt as it slowed down, thereby inducing the blades to 'flap'.

At a 'trip fuel' consumption rate of 150 lb/hr, the pilot should have expected the helicopter to have consumed 190 lb of fuel on landing at Folkestone, leaving him with 245 lb fuel remaining. He recalls having an indicated 200 lb at Folkestone but he did not question the discrepancy or make any allowance for the apparent 'trip' consumption rate of 185 lb/hr. Consequently, the pilot's initial fuel calculations were simplistic and did not make any allowance for start up and taxiing. Not performing a fuel burn check, either at Folkestone or en route, left the pilot with no way of monitoring his in-flight fuel usage, denying him the chance of accurate fuel monitoring to improve his situational awareness and to aid his decision making.

Subsequently the pilot failed to carry out the appropriate actions when the FUEL LOW caption illuminated, misbelieving that he had 15 mins of flight time remaining

before fuel exhaustion. By continuing the flight to the intended destination in conditions that required an immediate precautionary landing, the engine fuel supply was exhausted. The helicopter was then seriously damaged during the heavy forced landing.

Safety action pending

In 2005 the AAIB completed an investigation into an accident involving an Enstrom F-28A-UK, which was provoked by fuel exhaustion (see Bulletin 10/2005 registration G-BAAU). The Branch identified one causal factor as the complete absence of any fuel consumption data in the helicopter's flight manual. Consequently, in September 2005, the following safety recommendation was made to the FAA and copied to the helicopter manufacturer:

Safety Recommendation 2005-059

The Federal Aviation Administration of the USA should instruct the Enstrom Helicopter Corporation to include useful information on fuel consumption rates in all their Rotorcraft Flight Manuals.

The helicopter manufacturer decided not to act independently upon the safety recommendation because (quote):

'in accordance with the applicable regulations under which the aircraft was certified, ie CAR 6.743, Performance Information, fuel consumption rates are not "required" to be included as part of the performance information in the Flight Manual'.

Therefore, it seems unlikely that US manufacturers of light helicopters will include fuel consumption data in their flight manuals unless regulatory action is taken by the FAA. A formal response from the FAA to this Safety Recommendation was due after 90 days but it has not yet been received by the AAIB.