

HS.748 Series 2A, G-OPFW

AAIB Bulletin No: 9/2003	Ref: EW/A2002/11/02	Category: 1.1
INCIDENT		
Aircraft Type and Registration:	HS.748 Series 2A, G-OPFW	
No & Type of Engines:	2 Rolls-Royce Dart 534-2 turboprop engines	
Year of Manufacture:	1972	
Date & Time (UTC):	14 November 2002 at 2350 hrs	
Location:	Western Italian Alps	
Type of Flight:	Public Transport (Cargo)	
Persons on Board:	Crew - 2	Passengers - 1
Injuries:	Crew - None	Passengers - None
Nature of Damage:	Nil	
Commander's Licence:	Airline Transport Pilot's Licence	
Commander's Age:	44 years	
Commander's Flying Experience:	2,452 hours (of which 1,551 were on type)	
	Last 90 days - 99 hours	
	Last 28 days - 28 hours	
Information Source:	AAIB Field Investigation	

Synopsis

The aircraft was flying between Pisa and Paris when the crew received a Ground Proximity Warning System (GPWS) warning. Reacting to the warning the crew climbed the aircraft to a safe level where they encountered severe airframe icing. The resultant reduction in aircraft performance was such that they were unable to maintain level flight. Flying on or close to stick shaker operation the aircraft was forced to descend below the Safe Clearance Altitude (SCA). ATC vectored the aircraft away from areas of high terrain so that it could continue to descend safely to more benign conditions before continuing to Paris where it landed without further incident.

History of flight

The airline had recently started operations for a customer who required short notice reaction to move freight between multiple destinations in Europe. This required two aircraft and three crews to be based at Paris Charles de Gaulle (CDG) working '12 hour' standby shift patterns.

On the night prior to the incident, the crew, who were positioned at CDG, had flown a return flight to London Stansted finishing their flying duty period at CDG by 0300 hrs. At 1230 hrs the crew were woken by a telephone call from company operations tasking them to fly an aircraft from Rome to Pisa, continuing onto CDG later that evening. Having missed an earlier positioning flight, they

arrived in Rome at the scheduled time of their departure. They met with their ground engineer, who was to accompany them on both flights, and after some difficulties in obtaining their ATC clearance, departed Rome just over one hour late.

During the 'turn round' at Pisa, the commander supervised the cargo loading whilst the first officer, who was to be the handling pilot for the next sector, planned the route. He became concerned that one leg of their route had a Minimum Safe Altitude (MSA) of 15,900 feet and the aircraft they were flying had an operational ceiling of 15,000 feet. The crew discussed this and decided to fly the planned route at FL160. The commander reported that he had been told that a senior pilot within the company had successfully flown the aircraft to FL180 and that the company was seeking approval to remove the 15,000 feet ceiling limitation. The CAA however had no knowledge of any request seeking this approval.

The takeoff from Pisa was performed with water methanol assistance and they climbed to FL160 following a non-standard departure to 'SPEZI' waypoint. During the climb Milan Control offered a re-route to the north via 'CANNE' waypoint in the Swiss Alps, as opposed to their flight planned route to the west. The commander accepted the re-route but mistook 'CANNE' waypoint to be the CANNES/TANNERON VOR that is positioned close to the town of Cannes in southern France. Although the crew followed ATC instructions, which continued to take them northbound, there remained an element of doubt in their minds as to their final routing. Approaching Genoa (GEN) VOR on the Italian coastline, the crew received a GPWS 'PULL UP' warning and initiated an immediate climb. As they climbed through FL180 the first officer pressed the radio altimeter test button which immediately cancelled the GPWS warning.

The aircraft was levelled at FL180 and the crew decided to remain at this height as they were now heading towards an area with a higher MSA. A few moments later they noticed ice forming on the windscreen wipers and wings. All their anti and de-icing equipment was switched on and according to their instrumentation was functioning correctly, but the rapid build up of ice continued. They estimated that the ice thickness reached 4-5 inches on the windscreen with a 'clear area no bigger than a letter box to look through'. Power was increased to the maximum continuous limit on both engines but the speed slowly decayed from 150 kt to 120 kt. A descent was requested along their route but this was denied by ATC because of the height of the terrain ahead. At 120 kt the stick shaker activated and they were unable to maintain level flight. At this point they had passed 'CANNE' waypoint and were heading directly towards the Luxeuil (St Sauveur) 'LUL' VOR. Terrain within 10 miles of their track reached a height of 14,100 feet. The airspeed was stabilised with the stick shaker activating intermittently but this resulted in a descent with a vertical speed of approximately 500 feet per minute. In response to a further request for descent ATC vectored the aircraft to the north-east and authorised descent to FL160. At this level there was clear air which allowed the ice to dissipate and the airspeed to increase.

Eventually the aircraft was re-cleared to route to the 'LUL' VOR. When the crew altered course the aircraft re-entered cloud and almost immediately ice began to adhere to the airframe again and although the airspeed was indicating 160 kt the stick shaker activated. The crew were cleared to descend to FL100. The speed was increased in the descent to 205 kt before the stick shaker cancelled. After levelling at FL100 the flight continued in clear air to CDG with the ice clearing. The landing, carried out with approach flap, was without incident.

Visual inspection after landing revealed large lumps of ice remaining underneath the fuselage. The aircraft's de-icing system had appeared fully functional. Inspection of the de-icing system, after the aircraft landed at CDG, however, showed that a repair patch on the right inner wing de-ice boot was missing.

Meteorology

An aftercast obtained from the Meteorological Office, Bracknell, showed a slow moving frontal system lying over the northern edge of the Alps with a south westerly flow over northern parts of Italy. The main cloud base was 5,500 feet with layers up to 26,000 feet and a freezing level of

7,500 feet. The probability of icing within the cloud was extremely high, particularly in areas close to the front itself.

Flight Data Recorder (FDR)

The flight data recorder, a Plessey model 1584 Digital Data Acquisition and Recording Unit, (DARU) was removed from the aircraft and shipped to the AAIB for replay and analysis. Initially it was not possible to recover any data from the DARU. When the unit was stripped it was discovered that the recording tape had adhered to the tape drive capstan. This had eventually caused the tape transport system to jam.

The tape was removed from the recorder and replayed on a specialist transcription unit. Inspection of the recovered data revealed that the last complete flight recorded was three days before the incident. This was followed by incomplete recordings from at least three flights. No data was recorded during the incident flight.

The cause of the tape adhering to the tape capstan was attributed to problems with a batch of tape. The original specification 0.25 inch wide tape used in this flight recorder is no longer manufactured and prolonged testing of alternative tapes is necessary to ensure suitability for flight recording. This is an increasing problem with all types of tape based flight recorders as industry replaces tape media with semiconductor memory technology. Service organisations are sure that a suitable tape has been identified for the Plessey 1584 family of recorders and that as a result the reliability of this recorder will improve.

Flight planning

The company does not operate a computer based flight planning system, therefore, a set of flight plans and pilot navigation logs (PLOG's) for the 69 expected route permutations were manually produced by one of the company pilots. Copies of these PLOG's were kept on board each aircraft but on the day of the incident the crew were unable to find a copy of the 'Pisa to CDG' route. A copy of the correct PLOG was subsequently faxed to them in Rome. Flight plan information, usually annotated on the PLOG, was missing on this faxed copy therefore the crew were unaware of the cruising level that had been filed for them.

The MSA figures on the PLOG were calculated using the Aerad system of Safe Clearance Altitudes (SCA), which indicate safe clearance above known terrain within a particular grid area and are applicable for off-route altitude clearance. This would be used if the aircraft had to deviate off the airway for reasons such as weather or ATC direct routing. The MSA for flights remaining on the airway is the base of that particular airway and, as it only considers terrain within 20 miles of the airway centreline, is usually less restrictive than the off-route MSA.

The company operations manual 4.1.7 states that:

'at no time will the maximum altitude obtainable with all power units operating, or the appropriate stabilising altitude with one-engine inoperative, be lower than the calculated minimum safe altitude for that route, without specific company clearance'

The manual does not make it clear whether the '*minimum safe altitude for that route*' implies an off-route or en-route MSA. The PLOG only detailed off route MSA's. The company plan the route using the en-route MSA's and accept that conflict exists if the aircraft is forced off the airway into an area of higher MSA. In this case it becomes the commanders decision as to how best to proceed using appropriate company guidance, knowledge and experience. At the time of the incident, little of this was available to the crew.

On the actual route flown, the crew flew through an area with an off-route MSA of 16,400 feet and along an airway with a base of FL125. If they had experienced a single engine failure, their stabilising altitude, in the prevailing conditions, would have been approximately 4,000 feet *below* the base level of the airway.

GPWS

Radar recordings from Milan ATC showed that the GPWS warning was first encountered when the aircraft was flying at FL160 abeam the GEN VOR in a region where the MSA was 8,600 feet. The warning was therefore spurious and caused by an unserviceable radio altimeter. The crew however, reacted correctly to the warning by following the mandatory emergency manoeuvre set out in the company operations manual. They requested a climb from Milan ATC but did not declare an emergency.

Flight Time Limitations

The company first contacted this crew at 1230 hrs, nine hours after they went off duty. The company operations manual states that:

'the minimum rest period which must be taken before undertaking a Flight Duty Period shall be

- 1. at least as long as the preceding duty period, or*
- 2. 12 hours, whichever is greater*

When away from base when the rest period earned by the crew is 12 hours, and suitable accommodation is provided by the company, then the rest period may be reduced by one hour.

At the commander's discretion this rest may, in exceptional circumstances, be reduced to 10 hours.

Training

Although most company crews had flown charter operations to mainland European destinations, this was the first time the company had, for the long term, temporarily based crews in Europe.

The Air Navigation Order (ANO), Schedule 10 Part B paragraph (5) states that:

'The pilot designated as commander of the aircraft for the flight shall within the relevant period have demonstrated to the satisfaction of the operator that he has adequate knowledge of the route to be taken, the aerodromes of take-off and landing, and any alternate aerodromes including in particular his knowledge of:

- (i) the terrain;*
- (ii) the seasonal meteorological conditions;*
- (iii) the meteorological, communications and air traffic facilities, services and procedures;*
- (iv) the search and rescue procedures; and*
- (v) the navigational facilities.*

In preparation for this operation, the company produced five copies of a crew information pack. Three copies were kept at their Liverpool Headquarters and the other two were located on the aircraft at CDG. The information pack included several pages of flying considerations including methods for calculating MSA's extracted from the company operations manual. Several of the factors more pertinent to Alpine operations were mentioned in this pack eg single engine stabilising altitudes and mountain wave activity but there appeared to be little guidance available on their implications. The commander had signed confirming that he had read and understood the briefing notes for the CDG operation. There was, however, no specific training course for this operation.

Company crews are routinely educated on icing and its effect during their Operators Proficiency Check (OPC) and, even though there are no simulator facilities where crews can practice specific handling exercises in a benign training environment, they are frequently faced in reality with icing conditions and therefore have a good working knowledge of operations in icing conditions.

Civil Aviation Authority (CAA) Audit

In August 2002 the CAA conducted an audit of the company to inspect flight documents, flight time limitations, training records, facilities, the operations manual and the quality system. They found several non-conformities, particularly with regard to the training system and the related roles carried out by the Chief Training Captain, Director of Operations and the Chief Executive. In response to these non-conformities, the Company Accountable Manager and Director of Operations stated that:

'the culture of training will be addressed and changed and both would redress their actions in order to satisfy their terms of reference'.

The CAA re-inspected the company at the end of September 2002 and confirmed that these non-conformities had been addressed to their satisfaction. They also made the following comment:

'the operator's training system should be closely monitored to ensure that it is adequate and reflects the scale of the operation'.

Discussion

The operation from CDG was unusual in that it was the first time the company were expected to operate, for an extended period, with crews based in mainland Europe. The crew arrived at CDG with little or no specific briefings on their expected area of operations. The commander had signed that he had read and understood the briefing material that had been provided but in reality he had limited opportunity to study it. The crew were called within their minimum rest period and tasked to fly a route that, although planned to fly around the Alps, resulted in them crossing the Alps in an aircraft limited to a ceiling of 15,000 feet. Additionally they were to operate from two airfields that neither had operated from before. Although company crews are qualified to operate within the company's AOC region and assessed as competent during routine checks, many of them had limited overseas flying experience. The 'region specific' training given to the aircraft commander did not appear to have fully complied with the requirements of ANO Schedule 10, Part B paragraph (5).

At Pisa the crew were uncertain as to how to proceed on their flight plan route with an MSA higher than the aircraft ceiling. Furthermore, inconsistencies regarding the meaning of the phrase '*minimum safe altitude for that route*' may have enhanced their concerns. They decided however to accept the route and fly the aircraft at a level higher than the aircraft's authorised ceiling. This decision may have been influenced by a desire to achieve the task and a reluctance to delay the flight further, planning a new route. It is not possible to say whether this was due to pressure that was self generated or company imposed, nevertheless the resultant anxiety produced a far from ideal environment detrimental to considered decision making. Direct communication with company operations in Liverpool however, may have resolved the situation, helped to clarify their priorities and removed any doubts the crew had regarding the flight planned route.

Once airborne, the crew's situational awareness was degraded as they attempted to establish a clear idea of their routing. Their overall capacity was also possibly reduced and workload increased by the lack of an autopilot fitted to the aircraft. Much of their concentration was taken with attempting to locate waypoint CANNE and it is probable that this, combined with their lack of local knowledge and ATC procedures, influenced their decision to accept a re-route which did not meet the single-engine stabilising altitude requirements. Confusion regarding their position was further enhanced by the unexpected GPWS warning. Their reaction to this was timely and in accordance with company procedures. It was unfortunate however that initiating a climb placed the aircraft in conditions conducive to severe icing. Both situations were very serious in nature yet the crew did not declare an emergency. Had they done so ATC would have been able to renew the crew's confidence of their position, offer assistance and suggest alternative solutions.

Suitable pre-deployment preparation by the crew and more in depth briefing and training by the company could, for the most part, have pre-empted these situations and allayed the concerns of this and other crews within the company. Additionally, monitoring by the CAA of the training required for

the company to adequately prepare its crews for the scale of this European freight operation may have assisted the company in their preparation.

Follow-up action

As a result of this incident the company has reviewed and changed aspects of its training policy. Prior to departing on a CDG operation, crews now receive classroom training on European meteorology, ATC, navigation, MSA awareness, performance and technical matters. Attendance at this training is recorded on the individual's training file. The information pack, numbered copies of which are now distributed to all crews, has also been amended to include a complete section highlighting these same subjects. The company have also instigated a full check of all the PLOG's produced. Several discrepancies have been discovered and errors concerning MSA's have been corrected. Additionally the company is in the process of evaluating several automated flight planning systems with the intention of converting to the most suitable in the future. Notwithstanding the above the following safety recommendation is made:

Safety Recommendation 2003-61

It is recommended that Emerald Airways re-examine the adequacy of its flight planning system with a view to automating the process.