# FINAL REPORT

**AAIU Synoptic Report No: 2006-012**
**AAIU File No: 2005/0030**
**Published: 24/7/06**

**In accordance with the provisions of SI 205 of 1997, the Chief Inspector of Accidents, on 8 June 2005, appointed Mr John Hughes as the Investigator-in-Charge to carry out a Field Investigation into this occurrence and prepare a Synoptic Report.**

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| **Aircraft Type and Registration:** | WESTWIND 2 (1124A), N639AT |
| **No. and Type of Engines:** | 2 x Garrett TFE 731 SER |
| **Aircraft Serial Number:** | 308 |
| **Year of Manufacture:** | 1980 |
| **Date and Time (UTC):** | 8 June 2005 @ 13.05 hrs |
| **Location:** | Shannon Airport, Co. Clare, Ireland |
| **Type of Flight:** | Air Ambulance Flight |
| **Persons on Board:** | Crew - Two Passengers - Five |
| **Injuries:** | Crew - Nil Passengers - Nil |
| **Nature of Damage:** | Damage to LH wing de-icing boot and port engine fan blades |
| **Commander's Licence:** | US FAA ATPL |
| **Commander's Details:** | Male, aged 44years |
| **Commander's Flying Experience:** | 7,136 hours, of which 1,900 were on type |
| **Information Source:** | Station Manager, Shannon Airport AAIU Field Investigation. |

## SYNOPSIS

The Air Ambulance flight took off from Shannon Airport at 13.03 hrs enroute to St. Johns, Newfoundland and Miami. On climbing through 16,000 ft the crew heard a loud bang and noted a rise in the temperature of the L.H. engine. A visual inspection noted a section of the left de-ice boot had separated from the wing. The LH engine was retarded to flight idle and the aircraft returned to Shannon, where it landed safely at 13.24 hrs.

# FINAL REPORT

## 1. FACTUAL INFORMATION

### 1.1 History of the Flight

The crew conducted a routine pre-flight inspection of the aircraft and no concerns were noted. The aircraft, with one patient on board, departed at 13.03 hrs enroute to St. Johns, Newfoundland without incident. On climbing through 16,000 ft the crew heard a loud bang and noted a small rise in the ITT temperature of the L.H. engine. A visual inspection revealed that a 6 ft section of the left de-ice boot had separated from the wing leading edge. As a precaution the pilot retarded the left engine to flight idle conditions and the aircraft returned to Shannon without further incident. The crew did not declare an emergency. There was no further damage to the aircraft.

### 1.2 Aircraft Information

The Westwind is a twin-engine aircraft with a mid-mounted wing. This aircraft was imported into the United States from Venezuela in July 1995. The engines are mounted in the tail, above the wing (**Appendix A**). The aircraft is equipped with a pneumatic surface de-icing system. De-icer boots, made from fabric reinforced rubber sheet containing built-in inflatable tubes, are installed on the leading edges of the wing. Engine bleed air, reduced and regulated by the pressure regulator, is used to inflate the de-icer boots. An air ejector uses this regulated pressure to generate suction. This suction aids in boot deflation and is also used to hold the boots securely against the flight surface leading edges when the de-icer system is not in use. Inflating and deflating the tubes contained in the boots accomplishes de-icing of the flight surface leading edges. During normal operating sequence, the timer and distributor valve inflate and deflate the wing boots. A thin coating of conductive cement (A-56-B) is applied to the outer neoprene ply of the de-icer boots to dissipate the build up of static electrical energy. If this energy were permitted to accumulate, it would eventually discharge through the boot to the metal surface beneath, causing electronic interferences or damage to the de-icer boots.

When the normal cockpit switch is positioned to continuous, the timer signal programs the distributor valve, which sends pressure to the wing de-icer boot for six seconds and to the empennage de-icer boots for four seconds. The system then rests for 50 seconds. Each cycle takes one minute. In the event of timer failure the crew can go to MANUAL mode, which keeps the boots inflated. It is recommended that in this mode the pilot maintain the boot inflation for no more than 10 seconds.

#### 1.2.1 Boot Installation

The de-icer boot is bonded to the leading edge of the wing. The tubes which are inflated are integrated within the boot and run spanwise along the boot. Because of the curvature of the wing leading edge, the installation of the boot is very precise in order to avoid air pockets and wrinkling of the rubber. Materials used during the installation process include fuel barrier cement, Scotch-Grip 1300L cement, filler compound, conductive sealer, and a protective coating.

#### 1.2.2 Maintenance

There is a storage/shelf life for the boots but there is no definite service life when boots are installed on the aircraft. The boot should be inspected every 200 flying hours and all damage repaired promptly. The de-icing boot condition should be checked during each pre-flight inspection.

Cold Patch Repair Kits are available for temporary repairs. The application of recommended substances protects the boot from premature aging due to ozone and reduces adhesion of ice in service. Urethane coating systems can also be used to resurface weathered boots. There were no records available to the Investigation to show when the de-icing boots had been replaced or if they had been replaced since aircraft manufacture.

### 1.2.3 Operation

The aircraft manufacturers have issued a warning applicable to Ground De-icing/Anti-Ice Systems:

> *Caution: Do not operate wing and tail de-icing system at ambient temperatures below minus 40° centigrade to avoid cracking of the boots.*

Extremely cold temperatures make the boot very brittle and operation at these temperatures is sure to cause span-wise cracking along the surface of the boot.

## 1.3 Aircraft Inspection

The Investigation inspected the aircraft at Shannon Airport on the day following the incident. A 6 ft 6 in length of the LH wing boot had torn away and was missing (**see Appendix A**). 50% of the No.1 engine fan blades were damaged. The conductive edge sealer was in poor condition and areas of the boot had lifted or bubbled badly. A subsequent boroscope inspection of the engine did not detect any internal damage to the engine. Pieces of silver tape were found stuck to the leading edge of the wing where the portion of boot tore off. The Operator had purchased the aircraft in 2004. At Shannon a boroscopic inspection was conducted on the engine and engine fan blades repaired before the aircraft was flown back to the USA on an FAA ferry permit. The Investigation made a request to the Operator by E-mail that the removed de-icing boot should be returned to the boot manufacturer for testing along with an adhesive test of the starboard de-icing boot. However, neither test took place as the Operator said that he did not receive the request. The boots came off in pieces and were discarded.

## 2. ANALYSIS

No information was provided to the Investigation as to the age of the de-icing boots. As the photos at **Appendix A** show, both port and starboard wing boots were in poor condition. The length of boot which tore away revealed that very little of the adhesive cement had adhered to the wing surface. In addition, silver "high speed" adhesive tape was used to fill the skin contours. The aircraft manufacturer recommends the use of an aircraft structure filler for this purpose.

The aircraft was being used in the air ambulance configuration for flights over oceanic waters. Those who hire aircraft for such operations expect the highest standards of aircraft maintenance. If the boot had torn off later in the flight in icing conditions, the consequences could have been more serious. It is the opinion of the Investigation that the de-icing system in this case had not been maintained in an airworthy condition.

A study by the National Transportation Safety Board (NTSB) recently concluded that many of the air ambulance accidents could have been prevented with new technology, better risk assessment and tighter rules on flying in bad weather. The US FAA has also taken several steps in recent months to improve operational safety. It is expected that further regulations will be issued shortly in order to improve safety standards in the industry.

In the original Draft Report of this incident a Safety Recommendation was made to the European Aviation Safety Agency (EASA) that they should review the requirements for Emergency Medical Service (EMS) operations in order to set standards of safety within European airspace. EASA, in reply, stated that the Agency does not set standards for the operation of EMS aircraft and that the recommendation should be addressed to an appropriate organisation.

## 3. CONCLUSIONS

### (a) Findings

A length of port de-icing boot tore from the leading edge of the wing and was ingested by the port engine. As a consequence, a number of engine fan blades were damaged by boot material.

### (b) Cause

(1) Insufficient/poor bonding between the boot material and the surface of the wing leading edge caused portion of the port wing de-icing boot to depart.

(2) There was evidence that the boots had been poorly maintained in service.

## 4. SAFETY RECOMMENDATIONS

**4.1** The Joint Aviation Authorities (JAA) should review requirements for emergency medical service (EMS) operations in order to set standards of safety. (SR 04 of 2006)

# APPENDIX A


Top LH photo shows length of de-icing boot torn from the aircraft in flight. Top RH photo shows close up of fillers used during installation of de-icing boot. Bottom photos illustrate many areas of lifting and wrinkling of boot material on both port and starboard wings.

**- END -**