

SERIOUS INCIDENT

Aircraft Type and Registration:	Agusta A109E, G-ETPI	
No & Type of Engines:	2 Pratt & Whitney Canada PW206C turboshaft engines	
Year of Manufacture:	2001	
Date & Time (UTC):	27 June 2019 at 0820 hrs	
Location:	In flight North of Seaton, Cornwall	
Type of Flight:	Private	
Persons on Board:	Crew - 2	Passengers - None
Injuries:	Crew - None	Passengers - N/A
Nature of Damage:	Loss of window	
Commander's Licence:	Commercial Pilot's Licence	
Commander's Age:	55 years	
Commander's Flying Experience:	4,736 hours (of which 847 were on type) Last 90 days - 35 hours Last 28 days - 11 hours	
Information Source:	Aircraft Accident Report Form submitted by the pilot, maintenance organisation investigation and AAIB enquiries	

Synopsis

During a post-maintenance flight, the left cockpit door window separated from the helicopter. The window had been removed and reinstalled during recent maintenance. The investigation determined that insufficient adhesive had been applied to the rubber retaining seal. In addition, liberal application of high-concentration soap solution during reinstallation likely contributed to the loss of the window, by reducing the frictional ability of the rubber seal to retain the window. As a result of the findings of this investigation, the maintenance organisation has taken four safety actions.

History of the flight

Following completion of a lengthy base maintenance input, the helicopter was scheduled to perform a post-maintenance flight which included a track-and-balance check of the main rotor. It departed from Liskeard Heliport, with the commander occupying the right seat and an engineer in the left seat to record the track-and-balance data. The aircraft ventilation system was set to maximum as it was a hot day.

The track-and-balance check required data to be gathered in the hover, at 80 kt and at 140 kt. The flight initially proceeded uneventfully but as the helicopter was accelerated towards 140 kt, there was a loud bang and a substantial increase in wind noise. It was

immediately apparent to the commander that the window transparency from the left cockpit door had separated from the aircraft. There was no resulting increase in vibration, nor any indication that tail rotor control had been adversely affected. The track-and-balance check was terminated, and the helicopter returned to Liskeard, landing without further incident.

Maintenance history

During the recent maintenance input, the helicopter had undergone a full external repaint, which necessitated the removal and disassembly of all cockpit and cabin doors and windows. These tasks were documented as a single item on a maintenance worksheet, which was signed-off by the certifying engineer on 21 March 2019.

Following completion of the helicopter base maintenance and repaint, the doors and windows were reassembled and refitted by an engineer. The associated worksheet stated '*Cockpit, cabin and baggage compartment doors reassembled and reinstalled*' The worksheet did not record the date on which the task had been completed but indicated that it had been inspected and certified by the certifying engineer on 9 April 2019.

Installation of cockpit door windows

The A109E cockpit doors are of a composite construction and include a non-opening single acrylic window transparency. The window is attached to the door by an extruded rubber seal channel. The rubber seal has three separate grooves to accommodate the window, the door frame and a seal filler strip which locks the seal and window in place.

Chapter 56-31-7 of the A109E maintenance manual describes the procedure for installation of the cockpit door windows as follows. The numbers in parenthesis refer to the numbered items in Figure 1.

C. Installation procedure

- (1) Apply a layer of adhesive ...C537 (5) into the grooves of the seal channel (3) as shown in the section A-A.*
- (2) Install the transparent panel (2) and the seal channel (3) into the door frame (1).*
- (3) Using a small brush, apply a soapy solution into the groove of the seal channel (3) where the seal filler (4) will be installed.*

NOTE: make sure to install the seal channel and the seal filler as detail in [Fig 1].

- (4) Insert the seal filler (4) into the seal channel (3). When starting, hold the end of the seal filler (4) in position with a thumb and, if a new seal filler is being used, provide a slight overlap before cutting the seal filler strip to allow for a tight joint when both ends are forced into place.*
- (5) Butt ends and compress seal filler (4) into the seal channel (3).*

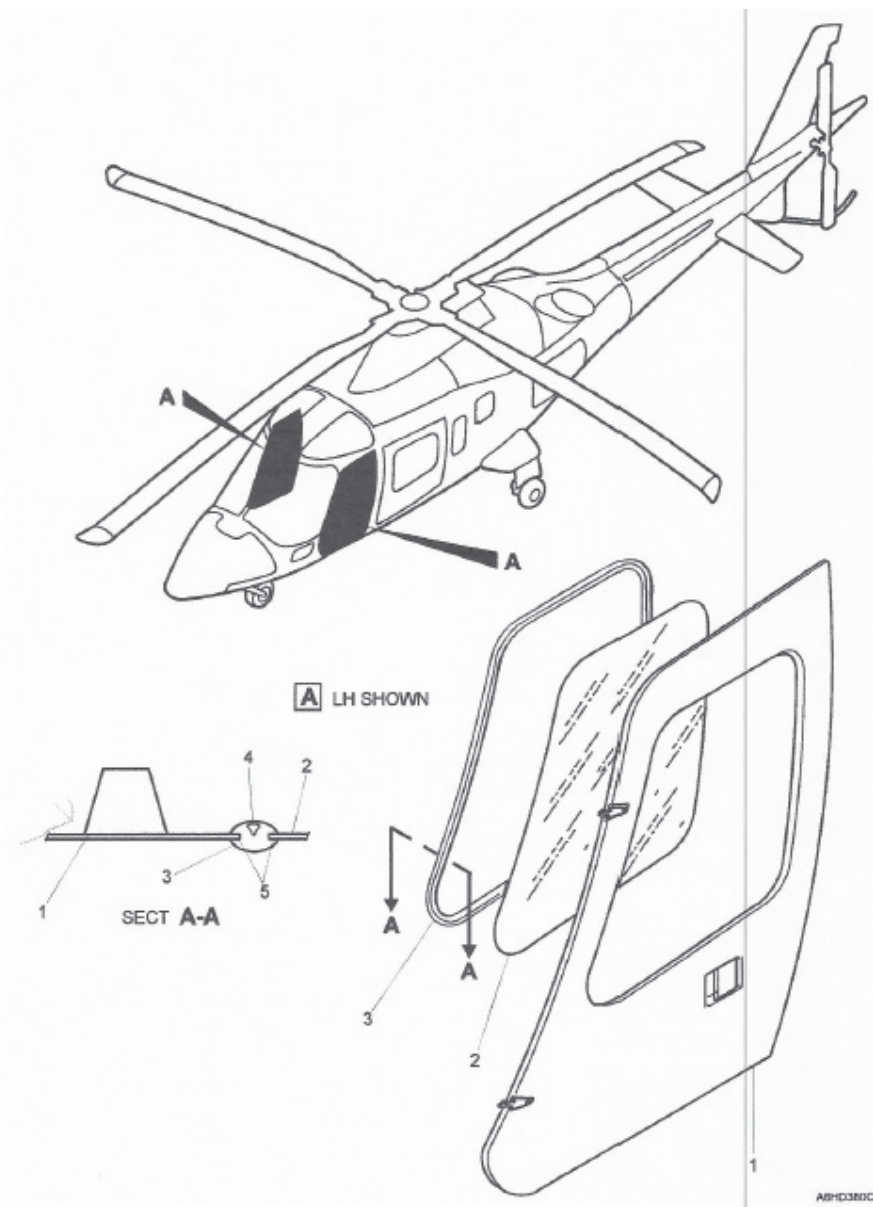


Figure 1

Illustration showing installation of A109E cockpit doors

Inspection of the helicopter

Following the incident, inspection of the helicopter's external surfaces did not reveal any secondary damage.

The left cockpit door was inspected and the associated maintenance worksheet stated that the inspection '*...did not reveal sufficient (residual) presence of adhesive on the door structure.*' The engineer performing the inspection also noted the presence of a greasy residue around the window aperture. A photograph taken during the inspection (Figure 2) shows no evidence of adhesive residue. The window and retaining seal were not recovered following the incident, so it was not possible to confirm whether sufficient adhesive had been applied to the window side of the seal.



Figure 2

Window aperture of left cockpit door, showing no evidence of adhesive

The right cockpit door window was removed for inspection and this revealed the correct presence of adhesive in the grooves of the seal.

The cockpit, cabin and cabin door windows were also inspected for correct installation and security. Maintenance worksheets for these inspections indicate that no defects were noted with the cockpit windows. Although adhesive was present on the cabin windows and cabin door windows, it was noted that there was '*minimal squeeze-out.*' In each case, additional adhesive was subsequently applied to ensure positive adhesion of the seal to the door structure and window.

The post-incident inspection and reinstallation of the cockpit, cabin and cabin door windows were carried out by the same engineer and certifying engineer who had completed the original window installations.

Internal investigation

The maintenance organisation undertook an internal safety investigation following the incident. It identified that the engineer who installed the left cockpit door window had experienced some difficulty fitting the seal filler strip to the seal channel. The engineer had used a soapy solution to insert the filler strip but acknowledged during the investigation that the solution was applied liberally, such that it covered the window and the concentration of soap had been stronger than might normally be used.

The C537 adhesive specified in the A109E maintenance manual is a multi-purpose silicone adhesive/sealant which adheres to most surfaces and cures to form a tough flexible rubber. A single 310 ml tube of adhesive was issued to G-ETPI during its original maintenance input. During the safety investigation a similar tube of adhesive with

approximately 1 inch of adhesive remaining was found in the hangar. It was determined that this was the originally-issued tube of adhesive and that it had been used during the original and post-incident window installations on G-ETPI. The maintenance organisation considered that, applied in correct quantity, the original and post-incident installation of all the cabin, cockpit and cockpit door windows would have required more adhesive than that which appeared to have been used. It would also have expected to see residual adhesive on the door frame.

The maintenance organisation's safety investigation concluded that the steps taken during reinstallation of the cockpit door windows differed from those prescribed in the A109E maintenance manual. It determined that little or no adhesive had been applied to the door side of the left cockpit door seal and that excessive use of an overly soapy solution to fit the seal filler strip had reduced the ability of the seal to retain the window due to friction alone. It considered the fact that the helicopter's ventilation system was set to maximum during the incident flight would have created a cabin pressure differential as the helicopter accelerated and this may have been a contributory factor. It believed the ram air effect of the ventilation system may have pushed the window outwards and caused the seal to roll off the door aperture, assisted by the lubricating effect of the soapy residue.

The maintenance organisation also determined that the certifying engineer did not perform a staged inspection during the task to confirm the presence of adhesive prior to installation of the window and seal. This was based on a perception that the task was relatively simple and that the engineer performing the task was fully competent to perform it correctly. The maintenance organisation also identified that its procedures did not make it clear that maintenance tasks involving steps which cannot be visually inspected or otherwise verified upon final completion, should be subject to a staged inspection.

The maintenance organisation did not identify any individual human performance issues with either engineer which may have contributed to the maintenance error.

Discussion

The A109E maintenance manual indicates the need for a thin layer of adhesive to be applied in the window and door grooves of the seal. Post-incident inspection revealed no evidence of adhesive on the left cockpit door window surround, which suggests that little or no adhesive had been applied to the corresponding seal groove during installation of the window. The window and seal were not recovered so it could not be determined whether adhesive had been applied to the window groove of the seal.

The A109E maintenance manual indicates that a small brush should be used to apply a soapy solution within the grooves of the seal filler channel. This suggests the need for precise application of the solution within this area. While the maintenance manual does not specify the concentration of soap to be used, other engineers in the maintenance organisation, indicated that one would normally use water with a light concentration of soap.

Using an excessive amount of soap solution would have allowed the solution to migrate into the window and door grooves on the seal (item 5 in Figure 1). In the 11 weeks that

had elapsed between installation of the window and the incident, the water would likely have evaporated leaving a soapy residue. This may have acted as a lubricant, which in combination with the absence of adhesive allowed the window to separate from the cockpit door.

Reduced supervisory oversight by the certifying engineer, based on their evaluation of both the task and staff competence, meant that stage checks were not conducted throughout the window installation task. Such checks may have identified and addressed the difficulties that the engineer experienced while installing the windows and/or the absence of adhesive on some of the window seals.

The maintenance organisation's internal investigation also identified that the maintenance paperwork relating to the installation of the cabin, cockpit and cockpit door windows task did not include adequate detail. Specifically, a collection of separate tasks had been documented as a single task and only the date of certification was recorded rather than date of completion. Although not directly relevant to the incident, this made it difficult to identify who was involved in which task and the order in which they had been done.

The post-incident inspection and reinstallation of the cockpit door windows was undertaken by the same engineer and certifying engineer who had done the original window installation in April 2019. The maintenance organisation's internal safety investigation was not commenced until several days later. The fact that the same engineers undertook the same task, on the same aircraft could have adversely affected their recollections of the original installation, when interviewed during the subsequent safety investigation. This may have affected the quality of information available to the investigation.

Conclusion

The left cockpit door window separated from the helicopter during a post-maintenance flight. The investigation determined that little or no adhesive had been applied to the door side of the rubber retaining seal during installation of the window. In addition, excessive use of an overly soapy solution to fit the seal filler strip may have reduced the ability of the seal to retain the window, which in combination with the absence of adhesive allowed the window to separate from the cockpit door. Deviation from the prescribed maintenance manual procedure and lack of effective supervisory oversight were identified as contributory factors.

Safety actions

Following its internal safety investigation, the maintenance organisation debriefed all involved staff on the findings of the investigation. On 28 August 2019 it issued a temporary notice to all engineers informing them of the incident and requiring the installation of windows to be considered as a critical maintenance task, requiring an independent inspection to be performed during the installation of any acrylic window. The task was subsequently included on the organisation's formal list of critical maintenance tasks, when it was next updated. The details of the incident are also to be included in company continuation training, with a

focus on the requirements for effective supervision, stage checks and adherence to procedure.

The maintenance organisation has undertaken to review its Emergency Response Plan (ERP) and to consider implementing a process to ensure that staff involved in maintenance activity prior to a suspected maintenance error, incident, or accident are stood down from duty, and are not allocated to be part of the maintenance response team. It indicated that the review of the ERP would be completed by the end of October 2019.

In September 2019 the maintenance organisation introduced a new production planning tool across all its maintenance bases to control and monitor to allocation of manpower, including supervisory staff, to aircraft undergoing base maintenance.