

DATA SUMMARY

LOCATION

Date and time	Friday, 4 June 2004; 11:40 h UTC
Site	En route Málaga-Ceuta

AIRCRAFT

Registration	EC-GPA
Type and model	BELL 412, s/n 36071
Operator	Helisureste

Engines

Type and model	PRATT & WHITNEY PT6T-3B
Number	2

CREW

Pilot in command

Age	37 years
Licence	Airline Transport Pilot (Helicopter)
Total flight hours	4,332 hours
Flight hours on the type	2,846 hours

INJURIES

	Fatal	Serious	Minor/None
Crew			2
Passengers			7
Third persons			

DAMAGES

Aircraft	Minor
Third parties	None

FLIGHT DATA

Operation	Cial. air trans. – Scheduled – Passengers – Domestic
Phase of flight	En route – Climb to cruise altitude

1. FACTUAL INFORMATION

1.1. History of the flight

On Wednesday June 2nd, 2004, the helicopter was carrying a scheduled flight with 11 passengers and two pilots on board between Ceuta and Málaga, and a passenger observed that the right hand forward window was slightly open at its rear part.

According to his statement, after landing he commented the fact one of the pilots and he answered that there was no hazard.

At Málaga Airport, a maintenance technician repaired the fixing of the window, for which purpose he applied a kit that included all the necessary materials, including a new retainer and new filler, and installed again the same window.

During the next flight to Ceuta, the window opened a little bit again, and after the landing it was replaced by a new window. Afterwards, there were several flights Ceuta-Málaga and return that were carried out without any report of further malfunctions of the window.

During the flight Málaga-Ceuta on 4 June 2004, with 7 passengers and two pilots on board and scheduled departing time 12:00 h UTC¹, the flight crew was the same of day 2 of June, and the passenger that then observed that the window opened, was now occupying the same lateral seat in front of the right hand forward window.

After some 15 min of flight, when the helicopter was at approximately 1,000 ft and 125 KIAS, several passengers noted a strong hit on the right. The passenger seated in front of the window noted a blow in the face that made him to lose the glasses. According to his statement, he covered his face with the hands and when he looked again the right forward emergency window had disappeared, leaving some «pieces of glass» inside the helicopter. He noticed that his nose was slightly bleeding. The passenger seated besides him tried to help him and also saw «plastic pieces» inside the helicopter. That passenger stated that he did not notice any strange behavior of any occupant before the detachment of the window, nor scenes of panic after it happened.

The pilots realized the situation and reduced the speed to about 80 KIAS. The flight continued without further incidences and it landed in Ceuta.

Another window was installed and the helicopter returned to service, and no further reports of malfunctions of this component have been received by the CIAIAC by the end of October 2004.

¹ All the times of this report are given in UTC time except when specifically noted. It is needed to add 2 h to obtain local time.

1.2. Similar events in the Bell 412 fleet

The CIAIAC was notified of a similar event in the Bell 412 EC-HFD happened on 16 February 2002. In that occasion, the most probable cause of the detachment of the left hand rear window was considered to be intentional manipulation of it by one or two passengers that showed strange behavior during the flight (see report IN-008/2002).

The operator stated that they did not have notice of any other detachment of windows in their fleet of Bell 412.

The manufacturer of the aircraft informed that they were aware of 3 instances for the 412 fleet where an emergency exit window from the sliding door separated in flight and then struck the helicopter. In two of those cases, the window hit the elevator and/or the vertical fin. Damage was very minor and the performance of the aircraft was not affected. It was determined, according to the information provided by the manufacturer that in these two cases correct window installation procedures was not followed.

In the third detachment the window stroke the main rotor blades and the tail rotor blades. The blades were not damaged and again the performance of the aircraft was not affected. The reason for this detachment could not be determined, although it was believed that equipment had fallen against the window.

The manufacturer revised their records of incidences with other medium civil helicopters and found three window separations during the last 20 years.

1.3. Description of the emergency window

The helicopter has two almost rectangular windows of clear acrylic material on each side of the helicopter that may be fixed at their lower corners with decals with the text «EMERGENCY PUSH HERE» to be used as emergency exits for evacuation of the occupants.

Every window weighs about 1,360 grams and its size is 700 × 575 mm. Its minimum thick must be 3.02 mm (0,119 in). It may be opened from inside and from outside the helicopter pushing at the same time both lower corners to extract the lower end from the seal and to allow the window to fall because of its weight. According to the information provided by the manufacturer, it is necessary to apply a force between 40 and 50 lb (between 20 and 28 kg) to the lower corners of the window to remove it.

The maintenance manual of the aircraft states that it is not recommended to remove the window unless required by window of retainer damage. Detailed instructions are

provided for inspection, removal and installation. Every time the window is removed from the retainer, the «retainer» (part 6 of Figure 1) and the «filler» (part 3 of Figure 1) shall be replaced. No repairs are allowed on both components. The retainer is bonded to both sides of the window frame all along its contour except in the curved area of the lower corners, to allow its opening by pushing those areas.

The maintenance manual states that every 300 h an inspection of the retainer must be carried out to detect lack of adherence to window frame, and it must be checked that both the retainer and the filler are free of damage, nicks, cuts and deterioration (swelling), etc.

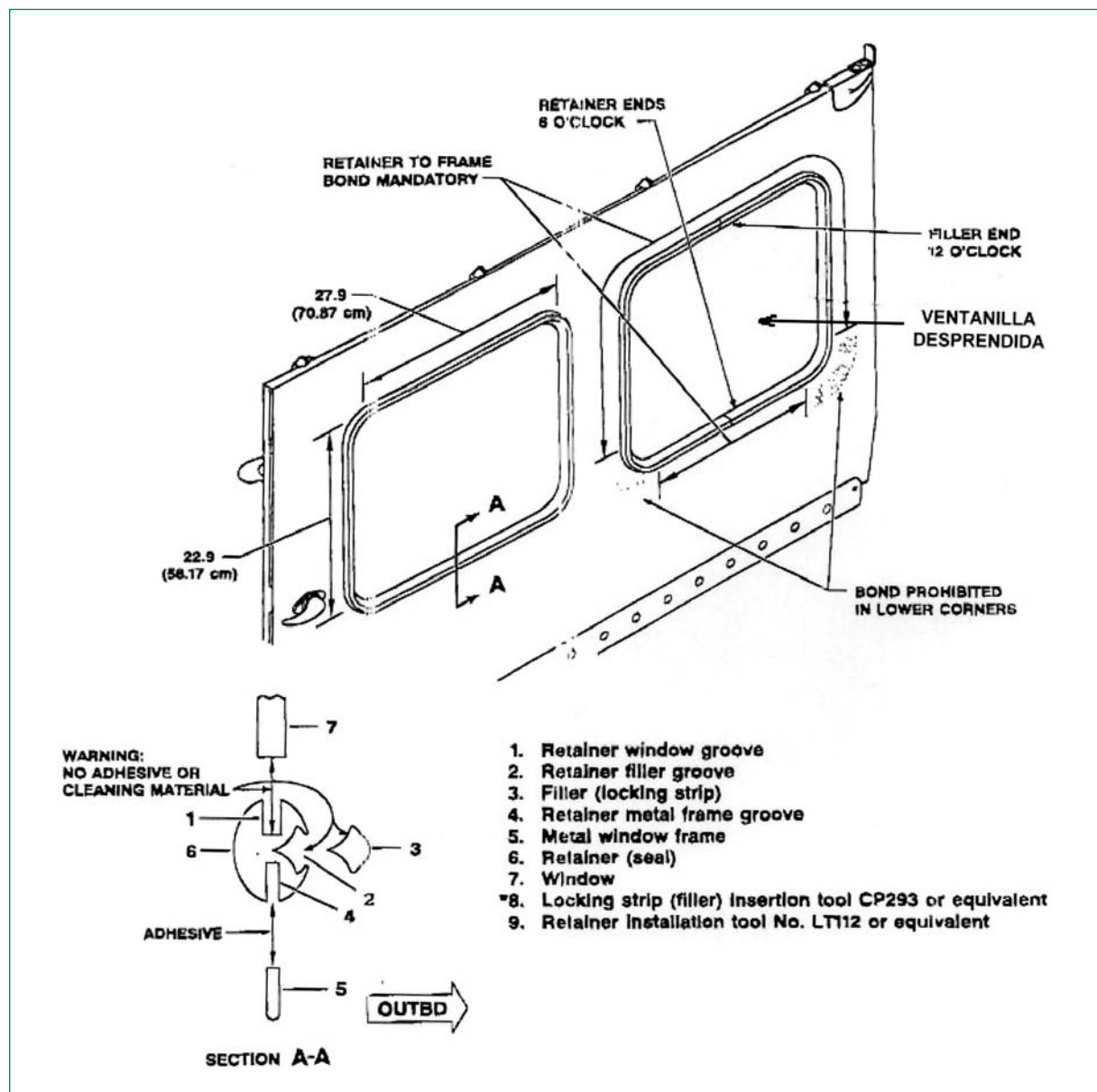


Figure 1. Drawing of the two windows of the left hand rear passenger door

The paragraph «installation» of the windows of the passenger doors gives instructions to install new retainer and window at the same time, that is, the case of installation of a new window on the previously used retainer is not included.

The installation requires the following periods of time to be applied:

1. Within one hour of applying adhesive to the retainer it is required to place the window in the retainer window groove and install the filler.
2. The helicopter must not be released for flight until the adhesive has cured for a minimum of 24 h at 24 °C (75 °F). Afterwards, the decals «EMERGENCY PUSH HERE» are installed.

1.4. Maintenance carried out on the window

Between 2 and 4 June 2004 the aircraft carried out, among others, the following flights (UTC times; C means Ceuta and M means Málaga):

Date	Flight	Departure time	Arrival time	Remarks
02-06-2004	207, C-M	15:21	15:50	A passenger saw that the RH forward window was slightly open.
02-06-2004	208, M-C	17:29	18:00	
03-06-2004	201, C-M	04:58	05:33	MAINTENANCE. Retainer and filler changed; the same window is installed again.
03-06-2004	202, M-C	07:38	08:10	Window again slightly open. MAINTENANCE. A new window is installed. The retainer and filler are the same.
03-06-2004	205, C-M	10:25	10:58	
03-06-2004	206, M-C	12:00	12:30	
03-06-2004	207, C-M	15:25	16:00	
03-06-2004	208, M-C	17:25	18:00	
04-06-2004	201, C-M	05:00	05:30	
04-06-2004	206, M-C	11:25	11:57	Detachment of the window in flight. MAINTENANCE. New window and retainer are installed.
04-06-2004	207, C-M	15:22	15:55	
04-06-2004	208, M-C	17:30	18:05	

Between 2 and 4 June 2004 the following squawks were noted relating the RH forward window of the helicopter EC-GPA:

Date	Flight	Squawk	Correction applied
02-06-2004	Ceuta-Málaga	A passenger observes that the lower rear corner of the window is open.	In Málaga, an airframe technician removed the window, cleaned the rest of adhesive from the frame, installed new retainer, applied adhesive to the frame, installed filler and installed back the same window. The task was recorded as finished on 03-06-2004.
03-06-2004	Málaga-Ceuta	The window in found again to be open.	In Ceuta, on 03-06-2004, the window is replaced by a new one (the same retainer is kept on the aircraft).
04-06-2004	Málaga-Ceuta	In climb to cruise altitude, the window and the retainer detach.	In Ceuta new retainer and window are installed.
By the end of 10-2004, no new reports of malfunctions have been received			The same window installed on 04-06-2004 remains in service by the end of October 2004.

On 03-06-2004 the helicopter and its engines had 4,159 h of service.

On 03-06-2004, when the first repair was carried out after a corner of the window was found open, the filler (see item 3 in Figure 1) was still in place, and there were no signs that the retainer or seal (see item 6 in Figure 1) had started to detach in that corner. The rests of silicone of the frame were removed and sandpaper was applied, according to the information provided by the technician that carried out the repair. The retainer was replaced using the corresponding original repair kit (P/N 412-669-100), provided by the official Bell supplier in Amsterdam. After the repair, the decals of «EMERGENCY PUSH HERE» continued installed.

On 3 June 2004, in Ceuta, a new window was installed and it was also an original Bell spare part included in the kit 412-669-100. The retainer was not replaced at that time (they were recently installed in Málaga). The information decals were installed in the new window.

2. ANALYSIS

2.1. Previous maintenance

According to the information gathered, the following conclusions may be reached:

- The replacement of the retainer of the window on 3-6-04 was carried out using original spare parts, and by a technician with experience on these kinds of tasks that

traveled to Málaga for this purpose. The technician had the relevant maintenance information and stated that the corresponding procedures had been followed. The tasks were recorded in the work order.

- However, after the next flight to Ceuta the same window was found again slightly separated from the frame in one of the corners, and in Ceuta the window was replaced using the same retainer.
- In the incident flight, no strange behavior or manipulation of the window by any passenger was observed. Therefore, it is considered that the detachment was not due to intentional opening.

From the maintenance records reviewed, it is concluded that it is possible that there was not a period of 24 h before releasing the helicopter back to service after the retainer was replaced in Málaga. Under those conditions, it is possible that the window slightly opened again in a corner due to the flight vibration. Although there are no details about the period used to cure the adhesive, the retainer was not found unstuck after that landing.

Then in Ceuta a new window was installed on the same retainer and filler that had been installed in Málaga.

There were no specific procedures for that task in the Maintenance Manual, because the paragraph «installation» of a window included the previous step of replacing the filler and, within one hour of applying the adhesive, the window was required to be put in place. The paragraph «52-84 Removal» of the Maintenance Manual stated «Discard filler... Discard retainer» every time the window was removed. Paragraph «52-85 Inspection» stated that «Retainers and fillers shall be replaced when the window is removed from retainer».

The new window did not suffer any incidence during several flights until the incident happened and both the window and the retainer detached and fell to the ground.

The information provided by the passengers show that the window detached suddenly and fell outside while it was breaking, in such a way that pieces of acrylic material remained inside the passenger cabin after hitting in the face of the passenger seated in front of the window. It is possible, especially if the detachment started at the forward lower corner that the air stream broke the window almost immediately, producing the «loud bang» mentioned by a passenger.

After the incident and the landing of the aircraft without further damage, a new window and retainer were installed at the same time and no additional reports of window malfunctions have been received. It has to be highlighted that after this installation, following the incident flight nº 206 (Málaga-Ceuta, landed at 11:57 h) the helicopter took off again at 15:22 h and it still carried out other two flights in the rest of that day 4 of June. Therefore, again in this case there was no 24 h period to cure the adhesive

before releasing the aircraft to flight and, however, there were no further reports of problems with the window.

In the maintenance carried out before the incident, apart from the period to cure the adhesive

2.2. Damage to the aircraft in the event of detachment

It was intended again to analyze the probability of impact of the window, after detachment, with other parts of the helicopter. Even if it seems that this probability is small because the generally descending flow caused by the main rotor, the manufacturer informed that they knew about three impacts in the fleet Bell 412. They also mentioned that were aware of other three detachments in other models of medium civil helicopters although, in these cases, it is unknown whether the windows came into contact with other parts of the aircraft.

The impacts in Bell 412 had no influence in the performance of the aircraft and did not produced important damages to the stabilizers or the blades. The opinion of maintenance technicians and pilots consulted about this issue was also that the damage produced by this window made of light-weight material would be very minor in the event of impacting in flight against other parts of the helicopter. In the case of the incident of helicopter EC-HFD (16 February 2002), there are no information that the window had hit the rotors. In the current case of EC-GPA, the window broke into pieces shortly after detachment, and therefore the probability of producing damages in other parts of the airframe would be even lower.

Despite this fact, a conservative approach from the point of view of safety makes necessary to consider the possibility that a small damage to the blades of the main or tail rotors could produce an unbalance that, if maintained during a long period during the cruise phase of flight could impose a hazard to the integrity of the rotors.

This approach leads to the conclusion that it would be convenient to minimize both the probability of detachment of the window due to intentional manipulation (case of the EC-HFD) or unintentional opening (case of EC-GPA), and the probability of the window hitting after detachment other parts of the helicopter.

For the case of unintentional detachment, it is considered convenient to act over the maintenance procedures to apply in the event of window replacement, to remark the fact that it is always convenient to replace the retainer and to assure that relevant periods to cure the adhesive are used.

To minimize the probability of impact against other parts of the helicopter, the addition of some means to keep the window besides de fuselage after its opening could provi-

de some improvement, although it is not an easy modification in view of the current design of the emergency exits.

3. CONCLUSIONS

It could not be determined with total certainty the reason why the right hand forward window and its retainer detached in flight, although it is possible that an optimum bonding of such a retainer was not achieved during its installation in Málaga on 3 June 2004 because the helicopter was released to service without waiting 24 h to cure the adhesive.

4. SAFETY RECOMMENDATIONS

REC 49/04. It is recommended to the operator of the aircraft that appropriate instructions are distributed to their technicians to remark the need to strictly adhere to the maintenance manual procedures when replacing the windows of the passenger door of Bell 412.