DATA SUMMARY

LOCATION

Date and time	**Monday, August 8, 2005; 16:50 local time[1]**
Site	**En route Ceuta-Malaga**

AIRCRAFT

Registration	**EC-HFD**
Type and model	**BELL 412 EP**
Operator	**Helisureste**

Engines

Type and model	**PRATT & WHITNEY PT6T-3D**
Number	**2**

Crew

Pilot in command

Age	**31 years**
Licence	**Airline Transport Pilot – Rotorcraft-Helicopter**
Total flight hours	**3,174 h**
Flight hours on the type	**2,099 h**

INJURIES

	Fatal	Serious	Minor/None
Crew			**2**
Passengers			**7**
Third persons			

DAMAGES

Aircraft	**Minor**
Third parties	**None**

FLIGHT DATA

Operation	**Comm. Air Transport – Scheduled – Domestic Passenger**
Phase of flight	**En route**

REPORT

Date of approval	**20 December 2006**

[1] Unless otherwise noted, all times in this report are local time.

1. FACTUAL INFORMATION

1.1. History of the flight

The helicopter was making a regularly scheduled flight between Ceuta and Malaga with 2 pilots and 7 passengers. At 16:50 (local time), at an altitude of 5,000 feet, the left rear emergency window became detached (see Figure 1) due to an inadvertent bump from one of the passengers, a minor who was traveling with his father. On noticing the situation and that the window had not impacted the helicopter's structure and had not caused any damage, the crew reduced altitude and velocity and calmed the passengers. The helicopter later landed without incident at Malaga Airport.

Foto 1. Helicopter general view

No passengers or crew members were injured.

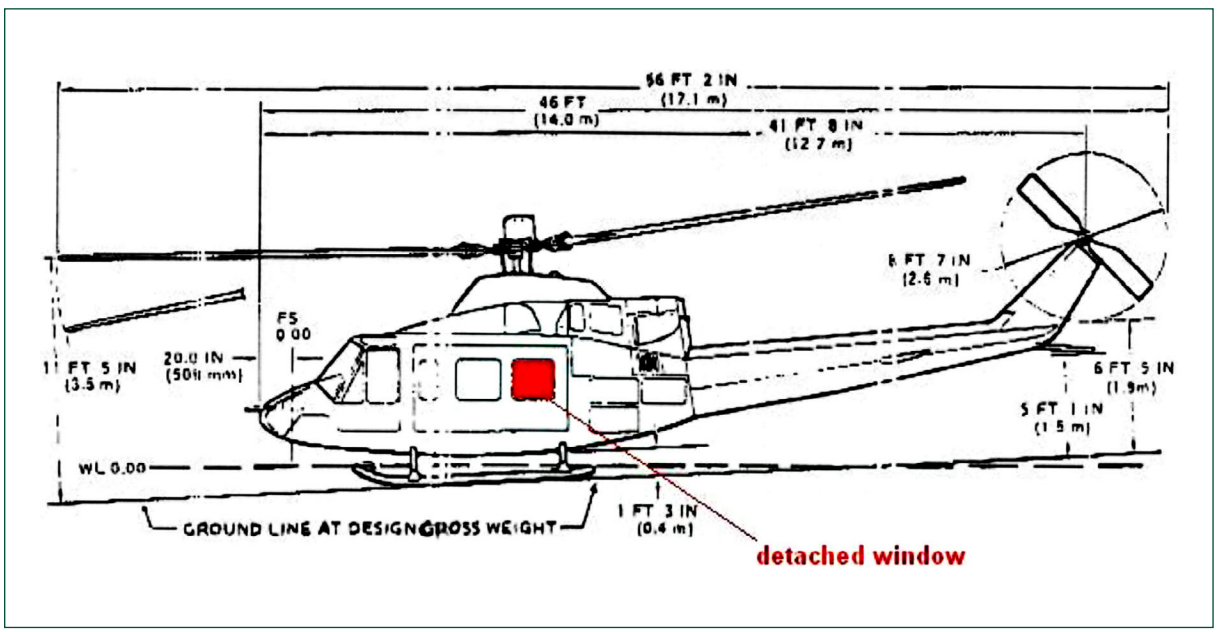

Figure 1. Position of the emergency window detached during flight

1.2. Crew information

The pilot at the controls held an airline transport pilot certificate with a rotorcraft helicopter rating, along with the following certificates: Radiotelephone Operator's Restricted Certificate (International), IFR, Fire fighting Pilot, A109, 109K, 109P, Bell 206, Bell 206L, Bell 212 and Bell 412. He had a total of 3174:15 hours of flying time, 2099 of them on the Bell 412 EP.

1.3. Aircraft information – Technical data and general information

Model:	Bell 412 EP
Serial number:	36183
Year of manufacture:	1997
Engines (2):	Pratt and Whitney PT6T-3D
Serial numbers:	TH 0195 and TH 0194

The aircraft registration was dated December 23, 1999 and its airworthiness certificate was valid (according to an extension issued on the basis of Circular Instruction 11-19B by Regional Office number 3 of the Civil Aviation Authority (DGAC)) until September 29, 2005.

1.4. Information on the emergency windows.

1.4.1. *Seating arrangement, location and description of the emergency windows*

According to data from the manufacturer, the helicopter has a capacity for up to 13 passengers (see Figure 2) who access the interior by means of two sliding doors situated on either side of the fuselage. All the seats face forward, except for four in the rear which face sideways. Each access door has two emergency windows, approximately rectangular in shape and made of a clear acrylic material. The rear emergency window is unique in that the two seats previously described as facing sideways face the emergency window.

The purpose of the emergency windows is to facilitate the ground evacuation of the helicopter's occupants in case of an emergency. To this end the window's opening mechanism consists of pushing one of the window's lower corners, which then detaches automatically. To inform the passenger of this mechanism, there are two stickers situated on each window's lower corners which read: «EMERGENCIA, EMPUJAR» («EMERGENCY, PUSH HERE») (see Figure 3).

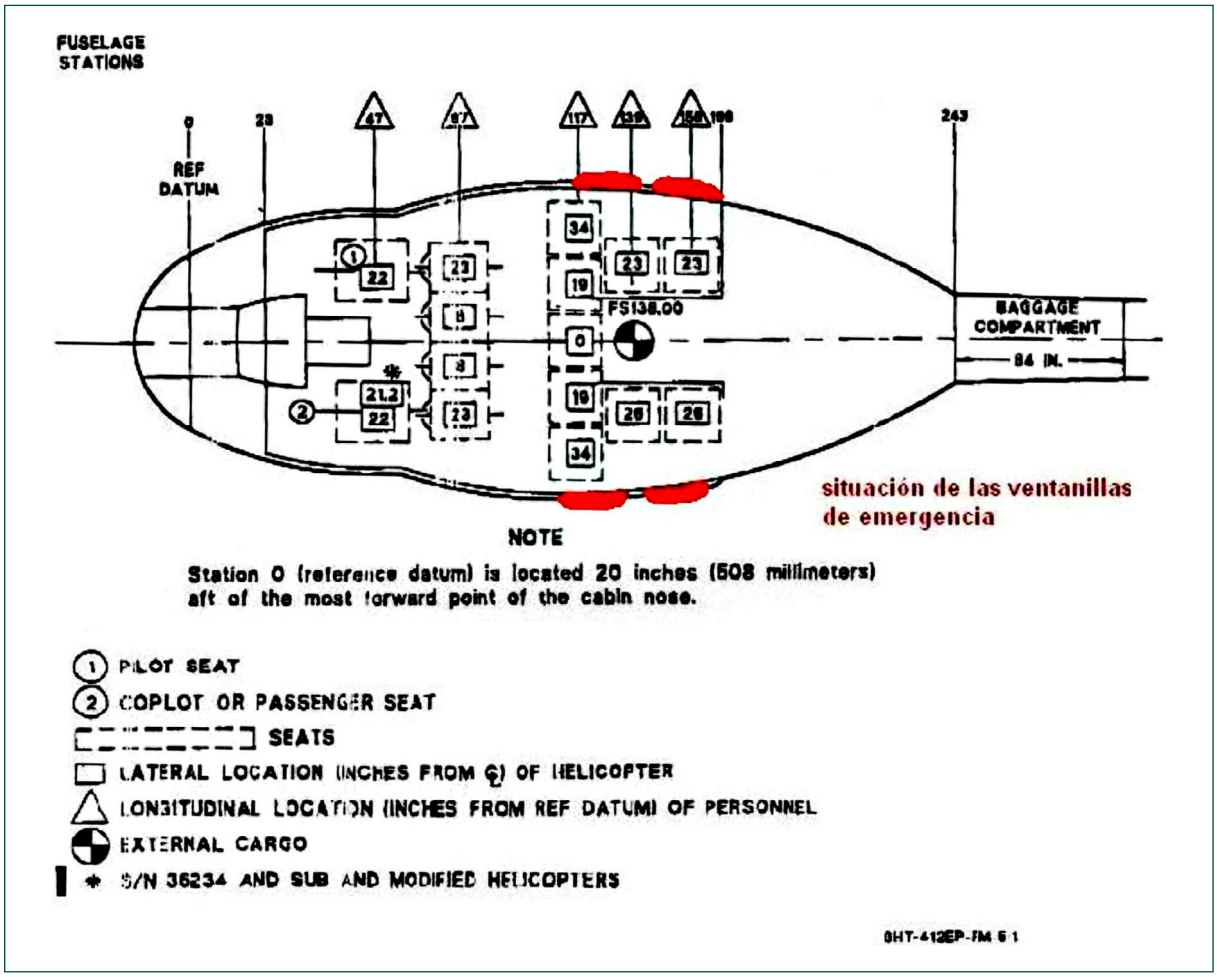

Figure 2. Seating arrangement and location of the emergency windows

Figure 3. Stickers located on the lower corners of the emergency windows

According to the aircraft's maintenance manual, each window opening measures 708.7 × 581.7 mm. The minimum required thickness is 3.02 mm. On previously investigated events, the operator had recorded that the window measured 700 × 575 mm and weighed 1,360 gr. The windows are attached to the helicopter structure's metallic frame by means of a retainer which is bonded at its perimeter to the metallic frame except at the two lower corners. The retainer keeps the window in place through the pressure exerted on it by the filler which is inserted into a groove machined into the retainer (see Figure 4).

The window can be opened by exerting pressure on one of the two lower corners (which are not bonded to the frame), which causes the lower edge to break free from the filler and the window to fall under its own weight. According to information provided by the manufacturer, a force of 50 lb (28 kg) on either lower corner is required to detach the window.

1.4.2. *Maintenance-related aspects of the emergency windows*

According to the helicopter's Maintenance Manual, replacing the window is not recommended unless the window or the retainer have been damaged. If this is the case, both the retainer and the filler must be discarded and replaced. Attempting to fix these two components is not permitted.

Maintenance inspections of the windows must be made every 300 hours. The inspection consists of a visual check of the filler to check for detachment, and both the filler and the retainer must be verified to be free from damage, cuts, swelling and nicks.

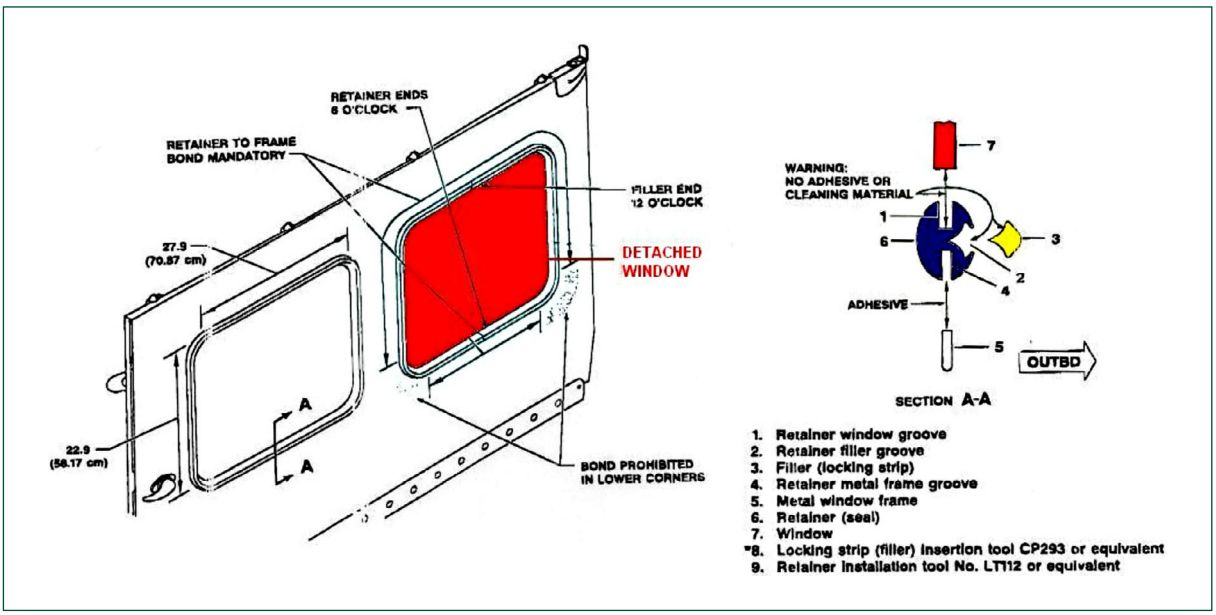

Figure 4. Diagram of the two emergency windows on the passenger door

1.4.3. *Previous window detachments in the Bell 412*

The CIAIAC is aware of two similar events taking place in the Bell 412 fleet.

The first happened with the same aircraft and window on August 16, 2002. On that occasion, the most likely cause for the window detachment was the deliberate manipulation by one or two passengers who had exhibited strange behavior during the flight (see report IN-008/2002).

In the second event, which took place on June 4, 2004, 15 minutes into the flight at an altitude of 1,000 feet, the forward right emergency window became detached and shattered, resulting in slight facial injuries to one passenger. In that case, the window had been replaced the day before when it was noticed that it was becoming detached. It was determined that the most probable cause was inadequate bonding time between the retainer and the frame, since the required 24 hours had not elapsed to let the bonding set properly.

1.5. Operator information

1.5.1. *Passenger safety briefing procedure*

The procedures used to inform the passengers about safety consist of:

— Showing a company DVD, both in Spanish and English, once the passengers are seated and before the engines are started, since there is no power for this DVD later.
— Safety cards located in front of the seats detailing the helicopter's safety guidelines.
— Specifically, the passengers located in the four side-facing seats in front of the emergency windows, once seated, are informed either by the maintenance crew or by the pilots not to lean against the windows once the sliding doors are closed.

1.5.2. *Maintenance tasks on the emergency windows*

The operator provided information regarding the instructions and work orders issued concerning the inspection of emergency windows.

There are three types of inspections:

— Pre- and post-flight visual inspections performed by the pilots/maintenance crew.
— A 25 hour/30-day inspection.
— And a 300-hour inspection.

The three inspections take into account the same aspects but to varying degrees. These aspects include checking the state of the windows (cracks, microcracks and reduced transparency), and that both the filler and the retainer are free of cracks, cuts and signs of deterioration, in addition to checking for proper bonding of the retainer to the window frame, except in the lower corners.

There is also a record of the report issued by the company to the Aviation Maintenance Technicians (AMT) regarding the requirement of strict adherence to the procedures in the Maintenance Manual when replacing windows. That report was a result of a Safety Recommendation issued by this Commission at the conclusion of report IN-038/2004 (REC 49/04).

1.5.3. *Emergency window maintenance history*

The operator reported that, since the window was not a hard time component, it did not have its own maintenance history, but the helicopter's maintenance history specifies that the window had been replaced in February of 2002 (replaced as a consequence of the intentional detachment described in IN-008/2002).

1.6. Manufacturer and certifying authority (FAA) information

The quantity and frequency of cases in which the window has become detached in flight is a cause of concern for this Commission, considering the reduction in the helicopter's airworthiness and safety, especially taking into account that every case that has taken place in Spain has been during a regular passenger flight

Because of this, and so as to identify possible deficiencies in the design/maintenance of the window, the resulting concerns were conveyed both to the helicopter manufacturer as well as to the authority responsible for the certification of various airworthiness components.

In principle, there is no provision for the in-flight detachment of an emergency window. According to requirement 29.809 of FAR regulations, specifically point *d*, the following requirements apply: «There must be a means for locking each emergency exit and for preventing opening in flight inadvertently or as a result of a mechanical failure».

In case of window detachment, the chances of it striking the main or tail rotor blades and causing structural damage to the helicopter depend on many factors, among them the state of the window after detaching (whether it shatters or remains intact), the aerodynamic characteristics the window assumes in the airflow, and the motion of the helicopter (accelerating, descending, etc.).

The manufacturer (Bell Helicopter) and the FAA were questioned about the following:

— Studies and tests conducted during the emergency window's design certification process on the possibility that, once detached, the window would impact against other parts of the helicopter, as well as the results of such an impact.
— The possible consequences of a window or window fragment impacting against the rotor(s) (main and/or tail)
— Methods for avoiding inadvertent in-flight detachment of the window as well as the possibility of including a restraining system which, in case of window detachment, would maintain the window attached to the helicopter structure.

The manufacturer replied to the questions posed by the Commission, basing its answers on the statistics gathered from the 14 known cases of in-flight window detachment since 1981. In three of the cases, the windows had impacted against other parts of the helicopter:

— One impacted against the left horizontal stabilizer, resulting in a small dent.
— Another impacted against the vertical and horizontal stabilizers, causing superficial damage.
— The last impacted against the tail rotor's four blades, causing minor damage.

Considering the history of in-flight window detachments, it was the manufacturer's opinion that both the window design and current configuration are satisfactory as long as installation and maintenance guidelines are followed, the warning stickers are in place and the passengers are properly informed.

The FAA replied that the emergency windows, when properly installed, are designed to withstand a pushing force of 50 pounds, as well as in-flight aerodynamic vibrations and forces. Out of the 14 cases in its database, 4 were attributed to passengers or cargo inadvertently pushing the window, while the cause in the seven remaining incidents was undetermined. In no case had the detachment led to significant damage to the helicopter.

The FAA concluded that there was insufficient cause to warrant corrective actions, although it did report that it had initiated a Service Difficulty Report (SDR #2006022807) to track the problem.

1.7. Statements

1.7.1. *Pilot statement*

The pilot stated that he did not see the motion made by the passenger which could have detached the window. He noted a change in the cabin pressure and noise level

and a passenger told him, by way of hand gestures, that the window had detached. The pilot warned the passenger sitting in front of the window not to touch anything and, once he verified that the window had not caused any damage, reduced altitude and velocity and proceeded to calm the passengers. The cabin is not pressurized and thus, in this regard, the window detachment did not pose any danger to the passengers. Since there is no provision for an in-flight window detachment, there are no established procedures for such a situation, though considering that the average cruising speed for these trips is about 120 knots, the pilot reduced speed to 80 knots to improve the flying conditions and passenger comfort.

The pre-flight inspection consists of a visual check of the physical state of the retainers and windows to verify that there are no cracks or signs of deterioration. The pilot added that for the particular case of EC-FHD, the stickers located on the emergency windows were also in Portuguese since the helicopter had previously been operating out of Portugal for some time.

The seats are not numbered and are not assigned on the ticket. In principle, the seats are chosen by the passengers themselves, though their condition, height and age are taken into account during boarding to avoid having unsuitable passengers occupying the side-facing seats.

1.7.2. *Statement of the passengers located in front of the detached window*

Once the helicopter landed, the Civil Guard, having been informed of the incident by the company, took statements from the passengers who had been sitting in front of the detached emergency window. The passengers were a father and his 14-year-old son, both Moroccan citizens who did not speak any Spanish. The father stated that his son, due to the confined space, accidentally struck the glass when crossing his legs, causing it to become detached. He further added that the glass had to be in a bad condition because the blow had been very slight.

2. ANALYSIS AND CONCLUSIONS

The following conclusions can be drawn from an analysis of the information provided:

— The window was last replaced in February of 2002 as a result of the detachment due to an intentional blow from two passengers, as detailed in incident IN-008/2002. No maintenance tasks had been performed on the windows, therefore, which could have led to any deficiencies when installing the new window.
— The maintenance technician who replaced the window involved in this incident confirmed that only the window became detached, and that both the retainer and the filler were in place. There were no indications, therefore, of improper bonding

between the retainer and the frame of the helicopter's structure or that the filler was worn. The window detached as designed (a blow to one of the lower corners and subsequent total detachment of the window).

— The locking method supposed to prevent inadvertent in-flight opening of the window, as specified by point *d* of paragraph 29.809 of FAR regulations, has not been clearly identified.
— The service offered by the operator normally entails the transport of passengers between Ceuta-Malaga-Ceuta, and thus the average passenger is of Spanish or Moroccan citizenship. The typical language spoken is Spanish, Arabic or French.
— The passengers occupying the side-facing seats are warned by the maintenance technicians or by the crew of the danger of touching the emergency windows. This task is carried out with the sliding doors completely open. It has been noted that in this position, the passengers are unable to see either the windows or the warning stickers and that, should they not understand the language, the explanation would be of limited use.
— The safety cards provided for the passengers are intended for those with a certain knowledge of helicopters and who routinely work with them (firefighters, aviation workers, etc.), and do not have information for passengers on security regulations or in-flight emergencies.
— The safety video shown when the passengers are aboard and before starting the flight only covers general safety topics and makes no explicit mention of how to open the emergency windows, of the danger involved in hitting them or of any emergency procedures.

In conclusion, it has been determined that the in-flight window detachment was caused by the inadvertent blow from the child as he adjusted his seating position, there being a limited space between the passenger and the window. It has been verified that a passenger can lean on the window even with the seatbelt fastened. An additional closing feature should therefore be provided to prevent inadvertent opening of the window in flight, as well as mechanisms to avoid damage to the helicopter's aerodynamic surfaces or injury to the passengers should the window become detached. In addition, the passenger must be reasonably prevented from inadvertently hitting the window by informing him of and verifying that he has understood the danger this action implies for the safety of the helicopter.

3. SAFETY RECOMMENDATIONS

REC 38/06. It is recommended that the manufacturer evaluate the possibility of including a modification to the design of the emergency window, adding a locking mechanism to prevent inadvertent in-flight opening to further reassure compliance with requirement d) of FAR 29.809 regulations and, in case of detachment, to prevent possible impacts with the helicopter's aerodynamic surfaces.

REC 39/06. It is recommended that the operator adapt the safety cards and DVD to the type of operation involved (passenger transport) in English and in Spanish and to consider including French to take into account the typical passenger profile involved in its services, as well as ensuring that the oral explanation given to the passengers in the side facing seats as the doors are being closed have been fully understood.

The operator has informed this Commission that it has taken measures pursuant to these recommendations and that the safety cards have already been modified. The safety video is still being modified as of the approval date of this report.