

# CIAIAC

Comisión de Investigación  
de Accidentes e Incidentes  
de Aviación Civil

## **TECHNICAL REPORT**

### **IN-076/2002**

Incident of the aircraft  
Airbus A-340-313,  
registered EC-GPB,  
at Salamanca Airport  
on 8 November 2002



MINISTERIO  
DE FOMENTO

# Technical report

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## **Foreword**

This report is a technical document that reflects the point of view of the Civil Aviation Accident and Incident Investigation Commission (CIAIAC) regarding the circumstances in which happened the event being investigated, with its causes and its consequences.

In accordance with the provisions of Law 21/2003 and Annex 13 to the Convention on International Civil Aviation, the investigation has exclusively a technical nature, without having been targeted at the declaration or assignment of blame or liability. The investigation has been carried out without having necessarily used legal evidence procedures and with no other basic aim than preventing future accidents.

Consequently, any use of this report for purposes other than that of preventing future accidents may lead to erroneous conclusions or interpretations.

This report has originally been issued in Spanish language. This English translation is provided for information purposes only.

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## **Abbreviations**

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00 °C	Grados centígrados
00° 00' 00"	Grados, minutos y segundos
AENA	«Aeropuertos Españoles y Navegación Aérea», ATC services provider
AGL	Above Ground Level
ATC	Air Traffic Control
CVR	Cockpit Voice Recorder
DH	Decision Height
DME	Distance Measuring Equipment
E	East
ECAM	Engine and Crew Alerting Monitoring
FDR	Flight Data Recorder
ft	ft
g	Acceleration of the gravity
GPWS	Ground Proximity Warning System
h: min: seg	Hours, minutes and seconds
hPa	Hectopascal
IAS	Indicated Airspeed
IFR	Instrument Flight Rules
KCAS	Knots of calibrated airspeed
Km	Kilometers
Kt	Knots
Kw	Kilowatt
lbs	Pounds
LH	Left
m	Meters
mb	Milibars
METAR	Aviation Routine Weather Report
MHz	Megahertz
N	North
N/A	Not affected
MN	Nautical mile
P/N	Part Number
RH	Right
S/N	Serial number
TOGA	Takeoff-go around
TWR	Control Tower
U T C	Universal Time Coordinated
VMC	Visual Meteorological Conditions
W	West

## 1. FACTUAL INFORMATION

### 1.1. History of the flight

On 8 November 2002, at around 10:30 h local time (9:30 h UTC), for the purpose of conducting a test flight after maintenance of the aircraft Airbus A-340-313, registration marks EC-GPB, a pre-flight briefing was started at the operator facilities at Madrid-Barajas Airport (called Madrid Airport through this report) with the attendance of a representative of maintenance, a quality control inspector and the pilot that was going to act as pilot in command during the flight. Afterwards, the pilot that was going to act as copilot joined the meeting.

Both pilots were qualified as pilot in command of A-340-313. The pilot in command of this flight had large experience in flight testing with this type of aircraft, including acceptance flights during delivery. He was also an instructor of A-340 and, therefore, was qualified to fly from the right hand seat of the cockpit.

The copilot did not have specific training in flight testing, and this was the first time he was going to participate in a flight test after maintenance in this type of aircraft. He had 3303 h of flight in A-320 and 19 h of flight time in A-340.

The maintenance conducted on the aircraft was an «IL» calendar inspection, which is carried out every five years.

The procedures of the operator requested that, after any important maintenance, a test flight be conducted following always a flight test plan prepared by the Engineering Department of the operator that was in general based on the test plan for acceptance of aircraft prepared by the manufacturer, although the former was simpler and did not include every item to be tested in the manufacturer's.

During the preflight briefing the items to be tested were reviewed.

It was first discussed the airport at which they were going to carry out the approaches that included the tests of the warnings of the Ground Proximity Warning System (GPWS): glide path, landing gear and flaps, to be tested during approaches ending in a go around maneuver. For this type of tests, they had used other times the airports of Santiago de Compostela and Sevilla.

In this case, the pilot in command suggested to use Salamanca Airport, that had several advantages. The representatives of maintenance and quality control stated that it was the captain's decision and that they did not have anything to add as far as the scheduled tests were carried out.

A representative of the Dirección General de Aviación Civil (DGAC) was also going to participate in the flight. The purpose of this participation was to carry out a spot check of the outcome of the maintenance tasks carried out.



Because it was a test flight, the Regional Office of the DGAC had granted a Flight Permit covering that flight, although the Airworthiness Certificate of the aircraft was considered still valid. For this reason, no inspector of the DGAC had to renew or specifically approve any document after the flight test.

Finally, a total of 10 people boarded the aircraft: the two pilots, a representative of quality control that would fill in the test results form, a representative of maintenance or production, that would act in practice as team leader during the test, a representative of the DGAC, another representative of quality control, and four maintenance technicians (two of them specialized in hydro mechanical systems and two specialized in avionics).

The takeoff weight of the aircraft was approximately 181500 kg (the MTOW is 275000 kg) with the center of gravity at 23.8% of the mean aerodynamic chord. The time of chocks out was 11:16 h UTC, and the takeoff took place at 11:42 UTC. The flight had the number IBE 0011.

The pilot in command was seated on the right side of the cockpit and the copilot on the left hand seat. The pilot in command was going to act as pilot flying (PF) all the time. After a normal takeoff from runway 36L and subsequent climb, they started the test in accordance with the test plan.

Some of the maneuvers performed during the flight were: maximum roll and pitch, engine shut down and start, systems operation, maximum pressurization, rapid depressurization, start of Auxiliary Power Unit (APU) at 40000 ft, overspeed warning, and stall in different configurations. Finally, they started the approach testing to Salamanca Airport. They used runway 21, that has a CAT I ILS.

During the briefing, proposed by the PIC, it was decided that they would carry out a touch and down and a go around to test different warnings of the GPWS. In the first maneuver, they checked that the flap warning was working (a voice sounds with the words «too low, flaps»). They touched down and started the take off run again, and then performed another approach during which the glide slope warning sounded when the aircraft descended one and a half dot below the ILS glide slope and also sounded twice the «too low, gear» warning that, according to the manuals, appears below 500 ft AGL when the gear is retracted. They continued the descend until the «too low, flaps» warning sounded. This warning appears below 250 ft AGL as measured by the radio altimeter when the flaps are not fully down.

Afterwards, the aircraft continued its descent, because, according to his statement, the PIC had the intention of checking the warning of the GPWS that appears in the case that the aircraft loses height after the starting of a go around maneuver. This warning includes a synthetic voice that says: «don't sink».

This tests was usually carried out by the pilot at around 50 ft AGL. In those conditions, when «takeoff-go around» (TOGA) thrust is selected, the flight director bars are displayed, and the horizontal bar provides guidance to obtain the maximum pitch angle depending on the energy that the aircraft has got at that moment.

They carried out this maneuver and the aircraft descended up to 58 ft and, without touching down, climbed up to 124 ft and descended again up to 26 ft over the runway. For 13 seg, the aircraft was within 34 ft and 38 ft of height while was over flying the runway, and no warning sounded during that manoeuvre. Then they climbed again to carry out another approach circuit, which was going to be a non-precision approach to runway 21. During the descend for that approach, according to the FDR data, the «don't sink» warning sounded during 3 seconds while the aircraft was at around 1161 ft AGL.

They continued that approach during which they checked that the autopilot disconnected automatically at the minimum selected height minus 50 ft, although this item was not included in the test plan, they landed and went to the apron to park the aircraft.

During the preflight briefing, after a proposal of the PIC, they had decided that, depending on the time used for the testing, they could stop at Salamanca Airport for a while to have some rest.

After parking the aircraft and shutting down the engines, the two flight crew members stayed on board the aircraft and had some sandwiches. The other occupants disembarked and went to the cafeteria, where some of them had coffee.

When they returned to the aircraft the PIC, according to his later statement, thought that the result of the last test carried out («don't sink» warning) was unclear. He decided to carry out again the test to be sure that the warning was working all right and commented this fact with the representative of the DGAC on board.

For the takeoff from Salamanca, the PIC was seated on the left hand seat of the cockpit, and the copilot took the right hand seat. The PIC was again the one acting as pilot flying (PF) all the time, while the copilot was acting as pilot not flying and was supporting the operation with the handling of communications, selection of systems according to the instructions of the PIC, selecting navigation headings, etc.

At 14:46:24 h UTC, Salamanca tower time (14:52:30 h UTC according to the aircraft FDR clock) the crew of IBE 0011 asked for permission to taxi. The ATC tower, in the frequency 121.85 MHz, cleared them to taxi to the waiting point of runway 21. At 14:47:32 h, the tower communicated that Madrid ATC had authorized them to proceed via Toledo, with FL 240.

At 14:48:08 h, the crew requested permission to carry out two fly-pasts over the runway, and added «...and to stay downwind to initiate the second fly-past».

The tower answered: «Roger» («Recibido» in Spanish) at 14:48:29 h.

The crew were cleared for takeoff at 14:51:24 h. The tower requested that they reported left base to runway 21 to carry out the first fly-past.

After the incident, several occupants of the aircraft stated that at the moment of that takeoff from runway 21 of Salamanca Airport they were sure that the test was completed, with the exception of the test of the ram air turbine or RAT that is normally carried out at the final moments of the flight test, and that the results of every test item were correct. Because of that, when the pilot asked for permission to carry out two additional approaches or fly-pasts that would end again in a go around, several participants in the test stated later on that they did not understand the purpose of those new maneuvers. They did not communicate these feelings to any of the two pilots.

The aircraft took off, carried out a circuit and reported «on short final» and was authorized to a go around with wind 270 and 8 kt. During the final approach the aircraft started deviating to the left of the runway axis when it was at approximately 300 ft of height and 1100 m away from the runway threshold, at 15:00:51 h (FDR time), with 209° of magnetic heading and 143 KIAS. The aircraft continued descending while the deviation was increasing, and reached 50 ft AGL to descend later on up to 28 ft of radio altimeter height.

The PIC, according to his later statement, at certain moment during the approach saw birds in a position that, as he remembered, taking into account the everything happened very quickly, was probably close to the end of runway 21. He remembered that at those moments he was over flying the runway and started an evasive maneuver with a shallow turn towards the left because, according to his perception, that area was clear.

At those moments the copilot, in accordance with his tasks of support and supervision, was looking towards the instruments panel, and watching closely the radio altimeter indications. When he noticed that the aircraft deviated towards the left he looked outside and saw birds, although everything happened too quickly to appreciate the number or distance of the birds. He looked again towards the instrument panel while the aircraft continued deviating from the runway axis.

Then, the occupants noted a heavy knock from the lower part of the aircraft, and at those moments the pilot applied left aileron control and pulled heavily from the pitch control. The aircraft started climbing while turning to the left.

The aircraft, after touching down with the main left and right landing gear legs on the parking apron and the adjacent terrain at 15:01:48 h, broke with the left leg an elec-

trical equipment well that was buried beyond the apron and hit with the fairing of the external fitting of the outboard flap of the right wing an abandoned sentry box of around 11 m of height that was located besides the fence of Salamanca Airport. The sentry box had a metallic structure, with crystal panels that formed the sentry cabin and a roof of zinc of around 60 kg of weight. The upper part of the sentry box, with a length of approximately 3 m, was cut by the aircraft and fell to the ground together with the zinc roof.

At the first moments after the hit, the PIC thought that they had hid with an engine an obstacle on the ground. After a first glance to the cockpit warning panels, other occupants thought that the impact happened with the landing gear. At those uncertain moments, other occupants still thought that they had had a tail strike.

According to their later statements, they noticed that several amber cautions appeared on the «Engine and Crew Alerting Monitoring» (ECAM) that showed malfunctions of the TCAS and of the four thrust reversers (i.e. they could be inoperative at the moment of selection during the next landing roll).

They realized that there was no failure at the pressurization system and that the aircraft was climbing normally. They checked several pages of the ECAM and saw that the hydraulic, electrical, wheels and brakes and other systems did not show any failure indication.

The crew selected flaps up and tried to retract the landing gear while the aircraft was still climbing. The flaps went up normally. However, the lever of the landing gear could not be raised, as the copilot could immediately notice.

The representatives of maintenance and quality control requested the technicians that were at the passenger cabin to inspect the aircraft and they saw, through the fuselage windows, that the external fairing of the right hand outboard flap was damaged, as well as the flap itself, that had lost a rectangular portion of 3 m per 0.9 m.

Inside the cockpit, several options were evaluated in relation with the information available at that moment. Since the aircraft seemed to be able to fly normally, except for the fact that the landing gear could not be raised, it was decided to return to Madrid and to carry out a landing with flaps and slats up, to avoid the possibility of a failure during the extension of those surfaces.

At 14:56:08 h. the tower ATC asked IBE 0011 to report when they were again on left base to carry out the second fly-past over the runway. The crew reported «On base» at 14:56:40 h. Then, at 14:57:43 h they requested to carry out the second fly-past and added: «and confirm me the landing gear is down». The tower answered: «Yes, roger, notify final» at 14:57:53 h. The crew acknowledged this instruction, but never complied with it.

The next ground to air communication took place at 14:58:16 h when the tower controller said: «Iberia 0011, apparently the gear is down». Four seconds later, the crew replied: «Towards Toledo, then». The tower controller said he understood they were already flying to Toledo and requested: «Report through eight zero».

At 15:01:06 h, when the aircraft was approaching 10000 ft during the climb, the crew asked whether they could stay at FL 160. The tower told them to contact Madrid Control at 136.52 MHz and asked for confirmation that they did not have any problem with the aircraft. The crew answered: «Thank you very much; could you confirm five one, the frequency, please» without referring to the possible problems on the aircraft. At 15:01:59 h the last communication took place when Salamanca tower said: «Roger, good flight».

The aircraft started the return to Madrid-Barajas and, at 15:24 h, the tower of that airport received a notice informing that Salamanca Airport had called stating that some remains of the aircraft had been found on that airport, and therefore, there could be some problem with the aircraft. However, Barajas tower was also informed that the crew were not requesting any special help. At 15:29 h, the Operations Coordination Service of Madrid-Barajas called the tower stating that the local alarm had been declared for the landing of the flight IBE 0011.

At 15:33:30 h UTC (Madrid ATC communications time) the aircraft contacted Barajas tower on 118.15 MHz to inform that they were established in the ILS of runway 33. At 15:36:35 h the aircraft was cleared to land on runway 33 with wind calm.

The landing was carried out with flaps and slats up, at a speed of 180 KIAS. After the touchdown, the thrust reversers were selected and they deployed and worked normally. When the aircraft cleared the runway, the brakes were at high temperature.

At 15:38:22 h, the tower transferred them to ground movements control (GMC) frequency on 121.85 MHz.

After the initial radio contact, the crew advised GMC that they intended to taxi to the operator's maintenance facilities in La Muñozza, and therefore they needed to cross runways 36R and 33. The GMC asked then whether they needed anything special and the crew answered: «No, anything, anything».

At 15:39:44 h, the ATC informed the crew that something was observed falling from the aircraft during the landing roll. The signalers of a "Papa car" that was in the south taxi area confirmed in the frequency that it was a flap bar of the right wing that was laying on runway 33, close to the intersection with runway 36R. A car was sent to recover that wreckage.

At around 15:40 h, it was decided to break the arrivals to runway 33 as a result of those remains over the runway. At around 15:49 h, after being confirmed that several parts

of the aircraft had been recovered from runway 33, the tower resumed the normal operation of that runway. Within that period of time, three approaching aircraft were commanded to perform a go around.

In the mean time, the GMC (South) told the aircraft that they had parts of the mobile surfaces hanging from the wing, and commanded the crew to switch the transponder to «standby».

At 15:44:33 h, the IBE 0011 had already crossed runway 33 and headed towards La Muñoza facilities.

Once stopped the aircraft, the damage to the aircraft was inspected and the occupants carried out a debriefing over the event.

In the flight log it was written 15:51 h as landing time, and 16:10 h as time «on chocks», with a «Block Time» of 4 h and 51 min, and with a touch and go, and two complete landings carried out during the flight test.

## 1.2. Injuries to persons

Injuries	Fatal	Serious	Minor/none
Crew			10
Passengers			
Others			

## 1.3. Damage to aircraft

The aircraft suffered important damages to the area of the right outboard flap. The fittings of the flap bar nº 5 were found deformed. The mobile support of de flap nº 5 was broken, and several of its parts were missing. The guiding bar of the mobile support of flap nº 5 was also broken. A part of the trailing edge of the right outboard flap was also broken and missing. Two rivets of the right lower part of the flap bar nº 5 were broken.

Additionally, the crew had reported that the landing gear would not retract. The lower trailing link of the articulated bar of the left main landing gear was deformed, in a mode that when the aircraft became airborne, the wheels rotated and the piston was extended the microswitch of ground-air signal was not pressed, and the system interpreted that the aircraft was still on the ground and therefore did not allow the gear to retract even when the gear lever was intended to be moved to the «UP» position.

The boggie pitch trimmer of the left main landing gear leg was changed, together with the LH MLG lower articulated link and its associated bolts. Later on, the complete assemblies of the left and right landing gear legs were changed, because it was determined that during the event both main landing gears have been subjected to high loads that could have exceeded the certification loads. In the case of the left leg, even the ultimate design loads could have been exceeded.

The TCAS was reported as inoperative after the flight, but the ground tests carried out determined that it worked all right.

### 1.4. Other damage

The aircraft broke a light well located close to the edge of the apron at Salamanca Airport.

During the collision with the abandoned sentry box, that had approximately 11 meters of height, the highest 3 meters of structure were cut by the aircraft and fell to the ground together with the roof of the box.

### 1.5. Personnel information

#### 1.5.1. *Pilot in command*

Age:	57 years old
Nationality:	Spanish
Title:	Airline Transport Pilot
Dated Issued:	21-10-1971
License validity:	30-1-2002 to 30-1-2007
Type rating:	Instrument flight, A-340 (within 5-5-2002 and 10-6-2003), Instructor of A-340 (within 21-4-2001 and 21-4-2004)
Total flight rime (until 31-10-2002):	14999 hours
Hours in the type A-340 (until 31-10-2002):	2245 h (pilot in command)
Hours last 90 days:	81 hours
Last simulator session:	4-8-2002

The pilot in command had large experience in flight testing during aircraft acceptance of new A-320 y A-340 aircraft, using an acceptance test plan at Airbus facilities near Toulouse (France). He remembered having carried out more than 100 flights similar to that performed the day of the incident.

He used to fly scheduled passenger transportation flights for the operator together as well as acceptance flights and, in general, test flights.

He had flown the following time during the five months:

- June 2002: 33 h (A-340)
- July 2002: 44 h (A-340)
- August 2002: 42 h (A-340)
- September 2002: 29 h (A-340)
- October 2002: 10 h (A-340)

On 6 November 2002 he received a call asking whether he wanted to carry out a test flight after maintenance. He had no other official assignment that day and he accepted the offer. He was told to select a copilot, and therefore he called another pilot of whom he had been his instructor recently.

### 1.5.2. *Copilot*

Age:	52 years old
Nationality:	Spanish
Title:	Airline Transport Pilot
Date issued:	2-12-1977
License:	Valid within 3-5-2001 and 3-5-2006
Type rating:	Instrument flight, A-340 (pilot in command, valid within 18-10-2002 to 18-10-2003), A-300 (valid within 26-4-2002 and 4-5-2003)
Total flight time (until 31-10-2002):	15432 hours
Hours in the type A-340 (until 31-10-2002):	19 h (pilot in command)
Hours in the last 90 days:	19 hours
Last simulator session:	A-300, 26-4-2002

The copilot had obtained recently the type rating of pilot in command of A-340, and had a total of 3303 h of flight in A-320. Therefore, he was not authorized to fly as copilot or first official (seated on the right seat of the cockpit) in aircraft A-340.



The pilot in command during the flight of the incident had been his instructor to obtain that type rating. The course had included 19 sessions of flight simulator of 4 h each. The proficiency check took place on 5-10-2002, and his latest flight before the incident was carried out on 23-10-2002.

The latest line check before the incident took place on 18-11-2001 in a A-300 aircraft.

The previous day to the incident he talked on the phone with the pilot in command for reasons not related to the operation, and he told him whether he wanted to participate in a test flight of the aircraft EC-GPB. The copilot answered on the positive and they agreed to meet the next day at the operators facilities at 9:30 h to carry out a pre-flight briefing.

### 1.6. Aircraft information

#### 1.6.1. *Airframe*

Make:	Airbus
Model:	A-340-313
Serial number:	MSN 193
Year built:	1997
Registration:	EC-GPB
M.T.O.W.:	275000 kg
Operator:	IBERIA, L. A. E.

#### 1.6.2. *Certificate of airworthiness*

Number:	4127
Date or renewal:	25-7-2002
Valid until:	25-5-2003

#### 1.6.3. *Maintenance*

Total flight time:	22479 FH
Total flight cycles:	2902 FC
Latest calendar (IL) maintenance inspection:	7-11-2002

#### 1.6.4. *Ground proximity warning system (GPWS)*

The aircraft was equipped with a ground proximity warning system that had 6 warning modes that provided aural and visual warnings under diverse circumstances.

Mode 3 of the GPWS, called «Loss of altitude after takeoff or go around» consists of a synthetic voice that says «DON'T SINK» in the event that the aircraft loses altitude during the initial climb or during a go around.

The conditions for the triggering of the warning are: height between 8 ft and 1500 ft, as measured by the radio altimeter, and a loss of altitude during 0.8 seg greater than 5.4 ft plus 0.092 times the radio-altitude in feet measured at that moment.

This warning is cancelled when the polarity of the altitude rate signal indicates climb rather than descent. At this time, the warning is cut off to indicate that recovery is being initiated.

During a takeoff followed by an approach and landing circuit the warning may be triggered, independently of the regime of engines selected, in accordance with the mentioned law of loss of altitude, but it is cancelled when flaps and gear are selected down.

#### 1.6.5. *Flight testing after maintenance carried out by the operator*

The operator systematically used to carry out flight testing after some maintenance tasks, for example, after calendar five-year (IL) inspections.

For that purpose, in aircraft A-340 they used a flight test plan (Ref. Section 4, «Flight Test» of the document «ME-NT-001 QJAR 37 Básica») that had been prepared by the Engineering Department of the operator. This test plan consisted of 42 pages, all of them dated on 17-9-2001, in the middle of which appeared in some cases copies of the operations manual of the A-340 as prepared by the operator.

On pages 35 and 36 of that test plan or protocol, there were tests to be performed on the GPWS, that included the triggering of the warnings «GLIDE SLOPE», «TOO LOW GEAR», «TOO LOW FLAPS», «100 ABOVE» Y «MINIMUM», but not the «DON'T SINK» warning.

The operator confirmed later on the they considered that the tests of the GPWS, as they were defined in the mentioned document «ME-NT-001 QJAR 37 Básica», were correct and necessary, and that the removal of those test items would not add value or more safety to the tests, and additionally would limit the test of this emergency system. That test is not referred to:

— Problems of loss of communication or low quality of that communication,

- Built in test of the equipment,
- Image quality of the warning display or sound quality of the aural warning,

which are tested on the ground, but to the actual checking in flight of the integrity of some of the sensor of the emergency systems of the GPWS under dynamic load.

The pilots that usually flew the acceptance flight test of new A-340 aircraft for the operator, used to have a test plan called «Operations Department Protocol» that did include the testing of that mode 3 of the GPWS.

### 1.6.6. *Flight test after maintenance recommended by the manufacturer*

According to the information provided by the manufacturer, «only operational and functional tests are required after maintenance activity on the GPWS system. It exists (E)GPWS ground test which enables to detect failure in any interface problems. This ground test is based on (E)GPWS BITE (“Built-in test”), and is used in all (E)GPWS retrofit-maintenance activities. Flight test will not add any plus value to (E)GPWS interface checking. Internal (E)GPWS Software logics are checked during development activities. That is why if inputs are available and Ground test succeed (with correct aircraft impacts: displays, audio...), it is considered the (E)GPWS is safe and well installed».

Furthermore a test flight manual is published by Airbus for the attention of Airlines. This manual describes serial of flight tests that are recommended after heavy maintenance or after C Check. In this manual, there are no tests relative to the GPWS system. This manual has the title «A-340 Test Flight Manual», Doc. 4730340/93, Rev. 3 – Dec. 99, and is sent as information to any airline that requests it.

The operator was not aware of the existence of that manual, and therefore it was not requested.

The manufacturer also provided information on the acceptance test plan used by the operator during the delivery of A-340 aircraft, including the «A340 Acceptance Flight Profile» for the serial number MSN 474. That plan included some tests of the GPWS during the second approach, with the intend of triggering the warning modes «TOO LOW GEAR» and «TOO LOW FLAP». For that purpose, during the automatic ILS approach, with the aircraft in CONF 3 with the landing gear retracted, and with the configuration CONF FULL selected on the «Multifunction Control Display Unit» (MCDU), when the aircraft descends through 500 ft the «TOO LOW GEAR» warning is triggered, and disappears when the gear is extended. The aircraft continues the descent and below 250 ft the warning «TOO LOW FLAP» sounds in the cockpit, and disappears when CONF 3 is selected on the MCDU.

Then, the approach is interrupted and a go around is initiated at the decision height, generally at 100 ft of height.

In that test plan there are no tests of the «DON'T SINK» warning.

In the past that test was carried out during acceptance flights, but later on that requirement was removed due to the difficulties of performing such a delicate maneuver with an increasing number of airlines and because of the annoyances of performing go-around at very low altitude.

### **1.7. Meteorological information**

The METAR issued by Salamanca Airport on 8-11-2002, near the time of the incident (14:52 h UTC) were as follows:

```
LESA 081430 27009 KT CAVOK 17/M02 Q1027 NOSIG  
LESA 081500 27008 KT CAVOK 16/M01 Q1027 NOSIG  
LESA 081530 27008KT 240V300 CAVOK 16/M01 Q1027 NOSIG
```

The report TAFOR (Terminal area forecast) at 11:00 h UTC issued by the Meteorological Office of the Base of Matacán, valid within 13:00 h and 22:00 h was as follows:

```
LESA 081100Z 081322 VRB04KT CAVOK TEMPO 1319 27007KT=
```

### **1.8. Aids to navigation**

The airport of Salamanca has an instrument landing system on runway 21, including two approach markers of 75 MHz (outer marker and middle marker). Additionally, the airport has VOR, DME and NDB.

The aids to navigation were operative and worked correctly during the incident.

### **1.9. Communications**

The communication systems of the aircraft and the ATC services were functioning normally.

The communications with Salamanca Airport ATC tower and Madrid-Barajas Airport ATC tower (aerodrome control and ground movement control), in the parts pertinent to the investigation, have been mentioned in several parts of this report.

## 1.10. Aerodrome information

### 1.10.1. *General characteristics*

Salamanca Airport is a Military Base open to civil traffic. There is a part with access restricted only to military aircraft and personnel.

It has two crossing runways. Runway 03-21 is made of asphalt and is 2500 m long and 60 m wide. Runway 08-26 is made of hard soil with a longitude of 2010 m and a width of 122 m, and is used by military aircraft only.

The communication frequencies are: 118.100 MHz Approach Salamanca (APP); 139.300 MHz Salamanca Tower (TWR) and 121.850 MHz Ground Movement Control (GMC). The tower frequency is devoted to the aerodrome control of both civil and military aircraft.

There is a civil apron (resistance PCN 70) and a military apron.

The Meteorological Office provides service H24 to both military and civil aircraft.

The Aerodrome Obstacle Chart ICAO-Type A published by the AIP Spain does not include any elevation beyond the limits of the obstacle limitation surfaces.

### 1.10.2. *Service of bird control at Salamanca Airport*

Salamanca Airport has a service to preclude the presence of sedentary or migrating birds that could represent a hazard for the aircraft. They use a group of 10 falcons specially trained that use to fly daily attacking isolated birds or flocks of birds in the area. The flights of the falcons are supposed to be carried out at different times and in several areas of the airport, to avoid the possibility that the presence of those predators can be predicted. Some time, aural systems to disperse the birds are used, as detonators or blank cartridges, which are useful for big birds as storks and cranes.

The normal procedure they use for bird control is that, when the tower controllers see birds, or receive reports of presence of birds, they advise the falconer who goes to the area to try to scare away the birds. The movements of the falconer must be authorized by the ATC.

The person that was on duty on 8-11-2002 stated that he did not have any communication of bird presence that day, and he did not carry out any specific activity of bird control. He stated that the falcons are usually located around 80 m away from the control tower.

The bird control service at the military base prepares activity reports every three months, including census of the observed birds at the Base and its surroundings. The most com-

mon birds observed in the third quarter of 2002 were starling («estornino»), wood-pigeon («palomas torcazes») and lapwings («avefría»). The number of birds observed within September and December 2002 were as follows:

Species/month	October	November	December
Lapwing («avefría»)	300	230	76
Starling («estornino»)	750	400	200
Wood-pigeon («paloma torcaz»)	26	17	40
Jackdaw («grajilla»)	26	20	7

The Department of Environmental Diagnosis and Verification of AENA was consulted regarding incidences of bird impact at Salamanca Airport. Their answer was that, after checking the data available since year 2000 at that airport, there was no report submitted regarding impacts during that period. They did not have data regarding observed fauna.

## 1.11. Flight recorders

### 1.11.1. Cockpit Voice Recorder (CVR)

The aircraft was equipped with a solid state cockpit voice recorder (SSCVR) Honeywell P/N 980-6020-001, S/N 0329, that recorded continuously the latest 30 min of four audio channels.

The aircraft was delivered by the manufacturer with a CVR P/N 908-6022-001 that was embodied on the aircraft on 20-10-1997. This recorder had a recording capability of 2 hours. Later on, the CVR was replaced several times for other of the same part number, until 20-10-2002, when the mentioned 30-minute CVR P/N 980-was installed.

According to the information gathered from the manufacturer, both P/N are electrically and mechanically interchangeable, and therefore there is no problem with the physical compatibility of both devices. The operational requirements JAR-OPS, paragraph 1.710, establish that the aircraft with more than 5700 kg of certified take off mass whose first certificate of airworthiness was issued before 1-4-1998, shall be equipped with a cockpit voice recorder able to record, as a minimum, the latest 30 min of operation.

As this aircraft was registered in 1997, the CVR installed at the moment of the incident complied with the requirements of JAR-OPS 1.

The sound file of this recorder was downloaded in a laboratory and information from the four channels was recovered, consisting of only 7 seconds of sound (file of 216 Kb) in which no information useful for the investigation could be recovered.

Three possibilities to explain the absence of sound were considered:

1. The download, decompression of files and play had been done incorrectly.
2. The CVR or the interface with the aircraft were not working properly and therefore almost nothing was recorded.
3. The CVR data had disappeared for any reason.

The first two possibilities were considered improbable.

Because the incident took place at approximately 15:01:45 h UTC, and the aircraft landed later on at Barajas Airport and crossed runway 33 at 15:39 h UTC, it was estimated that more than 45 min elapsed since the moment of the incident until the moment when the aircraft power was switched off, and therefore, even though the CVR would have worked properly and there was an available file of 30 min of duration, the information on the moment of the impact and the subsequent minutes would have been lost anyway. No additional activities on the SSCVR were performed.

### 1.11.2. *Flight Data Recorder (FDR)*

The aircraft had a Flight Data Recorder Honeywell, P/N 980-4700-003, S/N 0401, that recorded continuously several parameters of the aircraft during 25 h.

The data were recovered in a laboratory with capacity for that without any problem.

The data were analyzed, and the trajectory of the aircraft, together with graphs of several parameters during some of the maneuvers of the aircraft, are included in Annex C. The relevant information obtained from the FDR is analyzed in Part 2 of this report.

## 1.12. **Wreckage and impact information**

The aircraft was flying with runway heading when it deviated towards the left of the runway axis.

During that deviation, the aircraft descended until touch down with the main landing gear. Then, it ran for approximately 50 m over the ground. The first track that appeared and disappeared on the apron of the airport was that of the left, and after 15 m the track of the right leg appears and disappears, as shown in Annex A. During the ground contact the LH leg passed over and broke a well where the electrical transformer of the apron border lights is located.

Then the aircraft hit with the outboard flap pylon a sentry box of approximately 11 m of height. The hit cut the upper part of the box and wreckage from it were found up to approximately 50 m away from the sentry box.

Remains from the aircraft were found along approximately 120 m. They were found a part of the flap bar fairing, of 1.15 m of length, with a part of the guiding bar still attached, and a rectangular piece of the right outboard flap of 3 m per 0.9 m and a part of the flap skin, of 3.85 m per 0.42 m.

The impact was produced with the RH mobile flap pylon n.º 5. When it was inspected after the incident, the mobile support of de flap n.º 5 was broken, and several of its parts were missing. The guide bar of the mobile support of flap n.º 5 was also broken. A part of the trailing edge of the right outboard flap was also broken and missing. Two rivets of the right lower part of the flap bar n.º 5 were broken.

In the LH main landing gear, that was the first that touched down, the lower link was deformed. This fact made possible that a continuous signal of «aircraft on ground» was produced and therefore that the retraction of the gear was precluded.

In the brake assembly of the right landing gear there were remains of vegetation.

Therefore, the aircraft made the rest of the flight with the landing gear extended, and in view of the damage to flap n.º 5, the crew decided to land with flaps retracted.

The crew also had indication that the TCAS was inoperative, but during the landing this equipment worked correctly and, after functional tests, it was released as operative.

### **1.13. Medical and pathological information**

No occupant was injured because of the incident.

### **1.14. Fire**

There was no fire.

### **1.15. Survival aspects**

The occupants heard and noticed a violent hit, but were not affected by important accelerations or movements. Nobody was injured and the final landing was normal.



## **1.16. Tests and research**

### **1.16.1. *Aircraft trajectory***

The trajectory of the aircraft at the moments close to the incident was prepared from FDR data. It is included in Annex C.

### **1.16.2. *Witnesses statements***

#### **1.16.2.1. Witness at the apron of Salamanca Airport**

A witness with aeronautical experience, that was standing outside the airport terminal, saw the aircraft approaching at low height by runway 21, and could not appreciate very well the deviation with respect to the runway axis.

At a given moment, the aircraft appeared on the apron and touched down. The witness did not think that was an intentional touch down. He thought the pilot saw the sentry box and turned towards the left to raise the right wing to try to avoid the impact.

He observed that the aircraft had the landing gear and flaps extended. He thought that at the rotation, the aircraft lost altitude due to the drag and touched the ground.

The witness believed to have seen birds in the area. The presence of the witness on the area from which he saw the incident was casual, after having lunch. However, he noticed that there were a several people standing in the area, because it is not usual to see such a big aircraft at Salamanca Airport.

## **1.17. Organizational and management information**

### **1.17.1. *Requirements for flight testing***

It was not found specific requirements for the conducting of flight test after maintenance issued by the DGAC.

Section 1 of JAR-OPS 1, published through Royal Decree 220/2001, 2 March 2001, does not contain any specific reference to flight testing after maintenance. The paragraph JAR-OPS 1.905 «Manual of the Maintenance Organization of the Operator» indicates that the operator shall provide such a manual that contains the procedures to fulfill the responsibilities of maintenance of JAR-OPS 1.890.

The interpretative material of this paragraph 1.905 contains guidelines and examples about the content of that manual. Part 2 (Procedures of Maintenance) and Part 6 (Pro-

cedures of Maintenance JAR-OPS) should contain the corresponding procedures to carry out flight test after maintenance.

Regarding the requirements of the flight crews that perform flight testing, the requirements JAR-FCL (published through Order of 21 March 2000), specify in paragraph JAR-FCL 1.230 that for the purposes of flight testing, among others, in lieu of a class or type rating the Authority could provide a written authorization to the crew, with the validity limited to the conduction of a specific task.

This regulation means in practice that a pilot could carry out flight testing in an aircraft for which he is not type rated, as far as it is authorized by the DGAC under certain circumstances.

#### **1.17.2. *Organization and procedures of the Maintenance Department of the operator***

According to the information provided by the representatives of maintenance and quality control, those procedures detail the manner in which a flight test must be conducted, and indicate clearly who is the person that acts as test director. They also state that on board a flight test aircraft only may be people with a specific and defined function related to the test.

The test director must be sure that every item to be tested is completed in a satisfactory manner, and, if needed, he should request the items not adequately tested to be repeated during the flight.

However, those representatives remarked that the ultimate authority of the aircraft correspond to the pilot in command, who is in charge of selecting the test area and coordinating the flight with the ATC. Additionally, the pilot in command could refuse to perform some maneuvers or could conduct maneuvers that are not specifically requested by the test plan.

#### **1.18. Additional information**

None.

#### **1.19. Useful or effective investigation techniques**

None.

## 2. ANALYSIS

### 2.1. Flight preparation

The flight test was prepared in the normal mode by the «Subdirección de Revisión de Aviones» of the operator. For that purpose, they had a flight test plan for Airbus A-340, applicable to the aircraft registered EC-GPB, that had been provided by the «Engineering Department».

The representatives of production and quality control that were going to participate in the flight had long experience in flight testing with several models of aircraft.

It seems from the information gathered that the appointment of the crew of the flight was done without following any pre-defined method. The pilot in command had long experience in flight testing, but the selected copilot, apart from the fact that he was not qualified to fly from the right seat, because he was type rated as commander of A-340, had obtained very recently that rating, although with excellent results, and only had 19 h of flight on the type.

Taking into account the difficulty of the flight profile to be followed and the maneuvers to be carried out, and the high probability of incidences in that type of flights, it could be concluded that it would have been more convenient to select another copilot fully qualified to fly from the right hand seat, with large experience in A-340 and, additionally, with at least some experience in flight testing in that type of aircraft.

When the crew arrived to the hangar at around 10:00 h the day of the incident, they carried out a briefing on the tests to be carried out.

The briefing, in accordance with the normal practices of any flight test, had the goal of providing all the participants, and specially the pilots, with detailed and exact information about the maneuvers to be performed, in such a mode that everyone was in agreement with the test profile, expected results, etc. to avoid leaving anything to the improvisation during the flight.

However, in this case, the representatives of quality control and maintenance soon realized that the pilot in command was very familiar with the test plan being used, and therefore the sense of the briefing probably changed. However, every item of the test plan was reviewed and commented.

It could be suspected, from the information gathered, that it is probable that the large experience of the commander in this type of flights acted against the adequate planning of the tests to be carried out, because it seems that the commander knew in great detail and had used several times in the past the test plan of Airbus for delivery of aircraft, but did not know so well the test plan prepared by the engineering

department of the operator, and probably assumed that both plans were almost identical.

That was true except in some of the test items, including the test of the warning mode 3 («DON'T SINK») of the GPWS, that the commander had tested during deliveries of new aircraft but that was not included in the test plan being used the day of the incident, which only requires to test the warnings «GLIDE SLOPE», «TOO LOW GEAR», «TOO LOW FLAPS», «ONE HUNDRED ABOVE» y «MINIMUM», at which moment a go around is initiated without requesting any subsequent loss of altitude to trigger the «DON'T SINK».

To add more confusion, the testing of this mode 3 was included on the test plan called «Operations Department Protocol» that was sometimes used among pilots performing flight testing.

During an interview after the incident, that pilot in command made several references to the «Airbus Manual» and to the «Airbus recommendations [about the manner of performing some test maneuvers]», and this support the hypothesis that he always considered that the plan being used was almost identical to the one prepared by the manufacturer.

In any case, the representative of quality control was never aware during the briefing that there was any intention to carry out that test that was not a part of the official plan being discussed.

### **2.2. Madrid-Salamanca flight**

After the briefing, the aircraft took off and the first part of the test was completed without any incidence, with the aircraft commander acting as PF from the right hand seat, in accordance with his type rating as instructor of A-340, and the copilot seated on the left hand seat and acting as PNF, also in accordance with his type rating as he was commander of A-340.

At Salamanca Airport, they carried out an approach and touch and go to runway 21. During this approach the warning «TOO LOW FLAPS» sounded when the aircraft descended below 250 ft.

Then, they climbed up to 3700 ft of altitude (1500 ft AGL) and initiated a new circuit at that altitude and at around 140 KCAS. At the final turn, they started to descend again.

At 713 ft AGL sounded for two seconds the warning «SINK RATE» (excessive vertical speed) and at 3100 ft of altitude (645 ft of radio-altimeter) it was heard the warning

«GLIDESLOPE», that was repeated twice during the next 4 seconds. The aircraft reduced its vertical speed and leveled its path until capturing again the glide path, and then continued descending.

At around 495 ft of radio-altitude, when the aircraft had the gear up and flaps 26° the warning of «TOO LOW GEAR» was triggered, with 8 discrete signals recorded on the DFDR. The last signal appeared when the aircraft was at 302 ft of height.

Afterwards, at 231 ft, the warning «TOO LOW FLAPS» sounded for 4 seg while the aircraft was approaching 178 ft. After the first warning, flaps 31.5° were selected and the deployment was completed when the aircraft reached 142 ft AGL.

The aircraft continued its descent and at 79 ft, thrust was applied moving the four levers of the engines up to 85° of angle during 1 second, and the pitch angle of the aircraft was increased. However, the flaps were kept at 31.5° (full flaps configuration). The aircraft reached a height of 58 ft AGL and climbed briefly up to 124 ft, at which moment, with the thrust levers retarded, it descended again down to 28 ft above the runway, still with 31.5° of flaps. It was kept in almost level flight and between 34 ft and 38 ft of height for 13 seg flying over the runway, with a speed between 149.5 KCAS and 161.5 KCAS.

The flaps were then raised up to 22.5° and the thrust levers were advanced again up to 85° and the aircraft started climbing and increasing its airspeed until it reached 185 KCAS. The warning that the PIC, according to his statement, wanted to check did not sound at any time, because when the aircraft was losing height the flaps were still in landing configuration and the system did not interpret that a go around had been initiated. The aircraft climbed up to 3908 ft of altitude (1757 ft AGL) and started to descend while initiating a new approach circuit to runway 21.

When the aircraft was on that circuit, at 1161 ft of radio altimeter and with 290° of heading (almost perpendicular to the runway), with 142.5 KCAS, with 26° of flaps and with -22° of roll angle, the «DON'T SINK» warning could be heard for 3 seconds.

The aircraft continued the descending turn until it was aligned with runway 21, and eventually landed there with around 127 KCAS of speed at touchdown. The aircraft further reduced its speed and headed towards the parking where it parked and shut down the engines.

With respect to the maneuvers conducted so far, the following can be concluded:

- The first approach with touch and go was coherent with the intended test, although the plan did not call for a touch and go but for a go around, and was performed in accordance with the normal practice (some pilots reach de runway and others do not, depending on the development of the maneuver).

- The second approach, that was also supposed to end in a go around, was not carried out in accordance with the provisions of the test plan, because this called for the go around to be initiated after the warning «MINIMUM» at 50 ft, and guided by the flight director that would help maintain  $V_2$  plus 10 kt with a limit pitch angle of  $15^\circ$ . Instead of applying thrust and initiating immediately a continued climb when they reached 50 ft, the aircraft climbed up to 124 ft and descended again, because the thrust levers were retarded, down to a radio-altitude of between 34 ft and 38 ft for 13 seconds while it was flying past the runway. The commander's intention, according to his later statement, was to try the «DON'T SINK» warning, that was usually performed at 50 ft. However, from the information recovered, no explanation was found to the fact that the aircraft was leveled over the runway for 13 seconds. The commander said he was intending to trigger the warning anyway, but the logical action would have been, after losing some altitude from the initial 124 ft, to immediately initiate the climb to get away from the ground. The warning should have sounded under those conditions after losing 17 ft from that initial height of 124 ft if the aircraft would have been correctly configured for a go around maneuver, i.e. if the flaps had been raised from the full down position. This action was not taken until more than 13 sec later as previously mentioned.
- When the first and short climb was initiated from 58 ft AGL, the thrust levers were advanced briefly up to  $85^\circ$  for a second (climb to 124 ft) and then they were retarded again down to  $47^\circ$  or even  $2^\circ$  to keep the aircraft in level flight over the runway.
- In the next approach that ended with a full stop landing, the warning «DON'T SINK» sounded for three seconds, at 1161 ft over the runway. The PIC commented later on the ground that it was convenient to repeat that test, and the representative of quality control that was filling in the results report did not write anything after he heard the warning, and this was logical because the test plan form he was using did not request that test at any time.

### 2.3. Stop at Salamanca Airport

After the landing of the aircraft in Salamanca, the test team had been on board the aircraft for approximately three hours. They decided to have a rest, and the pilots remained on board the aircraft and the other participants went to the cafeteria of the airport.

The landing of a A-340 at Salamanca Airport was a novelty that aroused the curiosity of the students of a flight school located there.

According to the information gathered, a lot of those students had been at the apron observing the maneuvers of the aircraft during the previous approaches, and they remained there to see the subsequent take off.

For the new take off, the PIC was not sure that the previous «don't sink» test was carried out correctly and wanted to repeat that test. He commented this fact to the representative of the DGAC that was acting as an observer during the flight.

This decision should have been consulted with the representative of maintenance, and also with the representative of quality control, that was taking note of the tests results and ultimately had to validate their execution.

#### **2.4. Take off from Salamanca and impact with the sentry box**

When the aircraft started taxiing again, the PIC was seated on the left hand seat and the copilot on the right side of the cockpit, and the crew asked the tower «to carry out two fly-pasts over the runway» before returning to Madrid, «and to stay downwind to carry out the second fly-past». The tower answered saying: «Roger» («Recibido»), and, later on: «Cleared to enter and takeoff 21, wind two seven zero ten knots, report left base runway 21» at 14:51:24 h of the ATC tower clock.

The request to perform «two fly-pasts» was not in accordance with the need to repeat the mentioned test of the GPWS, which could have been carried out in a single approach.

When the crew reported «Short final» the tower answered «cleared for go around, wind two seven zero eight».

Just after the takeoff, when the aircraft was at 20 ft with 22° of flaps, «gear up» was selected and a steep turn to the left was initiated. At 200 ft of height, the roll angle was 46° and a maximum of 58° of left roll angle was reached when the aircraft was at 482 ft with 152 KIAS.

The climb to carry out the approach circuit continued (see Appendix C with a drawing of that circuit). At 760 ft gear down was selected. A maximum height of 1080 ft was reached in the circuit.

At 15:59:54 h the flaps started moving from 22° to 26°, which were reached after 6 seconds and then moved to 31.5° (flaps down) at 15:00:08 h. This «full» configuration was reached at 15:00:11 h.

In the mean time, with the aircraft at 933 ft, there was a GPWS mode 3 warning («DON'T SINK») for around 2 sec. This warning sounded as a consequence of the loss of 124 ft from the maximum altitude reached during the circuit of 1081 ft. According to the law mentioned in paragraph 1.6.4, this warning is triggered when the aircraft loses approximately 105 ft from the maximum of 1081 ft. The system interpreted that



the aircraft was still in the initial climb after the take off and, when it noticed that altitude was being lost, it triggered the warning that was inhibited when the flaps were extended to  $31.5^\circ$  (landing configuration).

The GPWS warning is recorded once per second in the DFDR. During that second, the height of the aircraft was varying approximately 25 ft under the conditions in which the warning was generated.

When the aircraft was approaching the runway and was 1100 m away from the runway, with  $209^\circ$  of true heading and at 300 ft of height with 142.5 KCAS, with the thrust levers located at  $48^\circ$ , it started to deviate noticeably to the left of the runway axis (see Annex C).

At 59 ft, the aircraft had 142.5 KCAS and continued descending down to 32 ft. At that moment, the aircraft had a true or geographic heading of  $205^\circ$  and was deviating more and more from the runway axis. The thrust levers were still at approximately  $48^\circ$ , and the aircraft reached 29 ft with  $-0.7^\circ$  of roll angle (wing almost level), and was kept below this height, reaching a minimum of 19 ft, during approximately 11 seconds, at a speed between 138 and 139 KCAS.

In those moments, there was a movement of the lateral control lever of the PIC up to  $4.9^\circ$ , and the rudder was moved to  $6.3^\circ$  to the left. Two seconds afterwards, the control lever of the commander was moved up to  $-7.7^\circ$  (lever to the right). Those movements of controls were then neutralized and made the aircraft to reach a maximum roll angle of  $-3.9^\circ$  (to the left).

The aircraft started varying its heading from the mentioned  $205^\circ$  to  $200^\circ$ . It was still flying between 30 ft and 35 ft during another 6 seg, with the speed increasing up to 145 KCAS.

There were several other movements of the roll control towards both sides, that reached up to  $-8.4^\circ$  (to the right) and  $5.6^\circ$  (to the left). The rudder was kept almost neutral in those moments.

The aircraft continued the deviation from the runway axis and lost altitude while the roll control was being moved to both sides (no pedal input was applied, but the rudder moved automatically as a result of turn coordination and yaw damping), until it touched down with a speed between 141 and 138 KCAS and heading of  $198^\circ$ . This contact with the ground happened over the parking apron of the airport, shortly before hitting the sentry box. Five seconds before touching down, when the aircraft was at 17 ft, there was a nose down movement of the pitch control towards  $4.2^\circ$ , and then the lever was moved nose up towards  $-10^\circ$ , but the descent was not discontinued. The thrust levers were still located at around  $48^\circ$ .



After touching down, left leg first and then right leg, the data of the DFDR indicate that both legs were compressed for less than a second, the wheels rolled and dragged over the apron (strong tracks of the tires were noted) and continued through the adjacent unprepared terrain along 50 m. The pitch angle increased up to 12.9°. The aircraft climbed while its speed was decreasing down to 136.5 KCAS. As soon as both legs were recorded compressed, the thrust levers were progressively advanced to TOGA within 3 sec, and when the aircraft was at 67 ft, they reached 85° of deflection and vigorous movements of the lateral and directional controls were made to produce a steep turn towards the left.

During the subsequent climb the roll angle reached a maximum of 44.3° (at 443 ft) and the pitch angle a maximum of 22.2° (at 1003 ft) and the speed reached a minimum of 120 KCAS (at 587 ft).

The impact with the sentry box happened when the aircraft was between 6 ft and 28 ft. Between these two samples of the DFDR, there is no noticeable change in accelerations or other parameters of the DFDR. This fact is coincident with the statements of some of the participants, that said that they felt and heard a strong bang but the aircraft continued its trajectory.

The sentry box is about 107 m away from the first mark of the track of the left leg of the landing gear. That means that within the first contact of the aircraft with the ground and the hit to the sentry box there were approximately 1.52 seconds (at a ground speed of around 70 m/s).

As a summary of the information compiled about this phase of the flight, it could be said that the intention of the PIC was to carry out two fly pasts over the runway, and that in the first of them the aircraft started deviating to the left through a gently application of roll stick inputs by the PIC that was initiated long before reaching the runway, approximately at 1100 m before the threshold, when the aircraft was at 300 ft of height.

For 24 sec the aircraft deviated from the runway axis without any increase of thrust or pitch angle, and without any other action taken from the cockpit to correct the situation.

No maneuver was initiated that could indicate that the GPWS warning was intended to be triggered as happened in the previous approach, that is, to descend to 50 ft, to climb again and to voluntarily lose some altitude afterwards. Instead of that, the aircraft was left in level flight at around 30 ft of height for approximately 11 sec.

No explanation has been found for the fact that the aircraft deviated from the runway during the mentioned 24 sec without any reaction of the crew. Only when the aircraft was close to touching down was the pitch angle slightly increased.

According to the statement of the PIC, it is probable that at those moments, the high degree of attention required by the delicate maneuver that he intended to perform was disturbed by the sight of birds with the result of the maneuver being distorted.

The copilot was initially watching the flight instruments looking inside the cockpit, as was the representative of quality control. They were checking specially the radio altimeter, because they were close to the runway and any small deviation in height could be hazardous.

However, when the aircraft started descending after the deviation of the runway axis until reaching approximately 30 ft, no occupant of the cockpit advised the PIC to correct the situation. There was a partial reaction shortly before the touch down and then a definitive correction after the impact with the ground and with the sentry box.

The considerations about bird sighting made under paragraph 1.10.2 above do not imply that there were no birds at the moments previous to the incident at Salamanca Airport, because the presence of fauna has a random nature and, obviously, not all the fauna present in an area may be sighted and reported.

However, the decision to deviate the aircraft after seeing the birds is questionable. No procedure of the aircraft, operational bulletin or other operation document recommends to carry out an evasive maneuver at such a low height in the event that birds are seen, although they do not recommend on the contrary, either. It is considered that the hazard of unexpected maneuvers when the aircraft is over flying the runway at such a low altitude is far greater than the hazard of flying through an area where birds could be present.

### **2.5. Salamanca-Madrid flight**

After the initial confusing moments, the crew determined in principle that the damages were limited to the right hand outboard flap and to the landing gear.

They decided to carry out another fly past through the airport to let the tower determine whether the landing gear was down and locked, and this was confirmed by the tower as far as they could see from their position.

With that information and after having reviewed several pages of the ECAM, they decided to return to Madrid flying with the landing gear extended and to land there with flaps and slats retracted.

Another more conservative option would have been simply to land immediately back at Salamanca and have the aircraft inspected, but according to the information available

to the crew, it cannot be stated that the decision to return to Madrid was unfortunate, because the aircraft was flying normally, except for the gear extended cruise, and no additional damage was observed apart from that to the flap in the different systems checked. The fact that the thrust reversers were inoperative, according to the ECAM information, also favored the decision to return to Madrid, where they could benefit from a 4100 m long runway compared with the 2500 m of length of the runway of Salamanca.

The logistic probably influenced the decision making because the operator did not have any maintenance capability at Salamanca.

On the other hand, Salamanca tower requested confirmation that they did not have any problem with the aircraft and (15:01:31 h tower clock) and there was no answer. It is logical to suppose that at those moments the work load and uncertainty were high inside the cockpit. However, it would have been convenient to inform about the impact to let the airport personnel inspect the remains of the aircraft that were left near the apron and provide feedback to the aircraft. The airport noticed the event after some time.

The aircraft returned to Madrid flying with the landing gear extended and at flight level 160. The crew did not request to the en-route control any special help, and did not declare emergency at any time.

However, the Madrid-Barajas airport personnel were advised that the aircraft had lost some parts at Salamanca, and they proceeded to activate the local alarm, at around 16:29 h local.

It is considered that this decision was conservative and appropriate for the safety of the airport operations. In fact, the aircraft lost a part of the flap during the landing roll on runway 33, and, as a consequence, three aircraft were commanded to perform a go around. Additionally, the brakes of EC-GPB were hot after the landing roll, and the corresponding amber caution was activated in the cockpit. Although the Firefighting Service had no need to intervene, it was convenient that they were prepared, because the aircraft was going to land without flaps or slats, with the reversers apparently inoperative, and with some uncertainty about the status of the landing gear.

The landing happened at 15:37:42 h UTC, according to the DFDR time (16:37:42 h local), at which moment there is a ground signal recorded for the right leg, and with a speed of 173 KIAS (185 kt of ground speed), and 7 sec later the nose leg touched down. The four thrust reversers were deployed 3 sec after the first contact of the RH leg with the runway.

The aircraft crossed runway 33 to head the maintenance facilities of La Muñoza at 16:43 h, and at 16:49 h local the normal operation of runway 33 were resumed.

### 2.6. Operational and organization factors

From the information and statements gathered, it can be concluded that the planning of the flight, regarding the maneuvers to be performed had been correct, as was the conducting of the flight test attending the sequence of the different test items and the results obtained. The maintenance and quality control representatives, as well as the pilot in command, had long experience in flight tests after maintenance.

The test plan prepared by the Engineering Department was not updated with the recommendations of the manufacturer, regarding the fact that after maintenance only operational tests on ground were needed to check the status of the GPWS. The operator stated that they were not aware of any recommendation of Airbus in that sense, and that in any case they considered necessary to carry out the tests as they had defined in their plan. Therefore, the operator was more stringent in their test requirements than the manufacturer, and this favors the safety in the sense that more systems are actually flight tested. However, some additional risk is taken during the corresponding flight test, although this risk cannot be considered by any means as "high", as it consists of performing a normal go around or touch and go to check different modes of the GPWS.

A factor that probably influenced the event was the large experience of the pilot in command in similar type of flight tests, although he was used to follow the acceptance flight test plan prepared by the manufacturer, that was not necessarily coincident with the operator's test plan. This could have increased the trust of the maintenance and quality control representatives on the decisions of the commander regarding the place to carry out the approaches (Salamanca), or to carry out other maneuvers not included in the flight plan («two additional fly-pasts» after the take off from Salamanca). However, the statements gathered support the conclusion that every test point was reviewed in the pre-flight briefing and that in any case was agreed that a «don't sink» test would be carried out. Several participants highlighted that the ultimate decision over the aircraft rests with the pilot in command.

The appointment of the crew to carry out the test did not follow any pre-established procedure, as far as it is known, and the copilot had little flight experience in A-340. As he was qualified as commander of this model, he should not have occupied the right hand seat of the cockpit at any time. Additionally, maybe the cockpit gradient regarding experience and qualifications was not ideal, because, in addition to the fact that both were qualified as commanders, the pilot in command had recently been instructor of the other pilot, and both had high mutual confidence regarding the flight capability. This fact could explain that the copilot did not react when the

aircraft was deviating appreciably from the runway axis at Salamanca and losing altitude, and that at no moment put in doubt the commander's decisions regarding the maneuvers.

Therefore, it could be concluded that it would be convenient that the operator reviewed their procedures to appoint flight crews for tests, to develop flight test plans, and to carry out the flight test.

### 3. CONCLUSIONS

#### 3.1. Findings

1. Both pilots on board were type rated as pilots in command of A-340.
2. It was intended to carry out a flight test after maintenance using the test plan of the operator reference «ME-NT-001 QJAR 37 Básica, Section 4, EC-GPB», that does not include the test of the warning «DON'T SINK» of the GPWS.
3. The aircraft carried out an approach to Salamanca Airport in which it was kept in flight almost level between 34 ft and 38 ft AGL during 13 seconds over runway 21, at a speed between 149.5 KCAS and 161.5 KCAS, until a go around was initiated.
4. During the subsequent circuit, the warning «DON'T SINK» sounded for three seconds when the aircraft was at approximately 1161 ft AGL.
5. Before the next take off from runway 21 of Salamanca Airport, the crew requested the Control Tower to carry out two fly-pasts over the runway before proceeding back to Madrid.
6. After the take off, a new approach was carried out during which the aircraft flew over the airport at a height equal to or less than 36 ft for approximately 20 seg.
7. During that approach, the aircraft started deviating to the left of the axis of runway 21 when it was approximately 1100 m away from the runway threshold and at approximately 300 ft AGL, due to the lateral control inputs made by the pilot in command. There was no increase of thrust while the aircraft was deviating.
8. The pilot in command stated that he saw birds and therefore deviated voluntarily the aircraft from the runway axis. During that deviation, the aircraft touched down with the left and right main landing gear in a place close to the edge of the parking apron of Salamanca Airport.
9. The aircraft hit with the mobile support of RH flap N.º 5 and with the outboard RH flap an abandoned sentry box of 11 m of height that was located between the parking apron and the exterior fence of the airport.

#### 3.2. Causes

It is considered that the most probable cause of this event was the inadequate commanding of an approach maneuver to runway 21 of Salamanca Airport, during which the aircraft deviated very noticeably from the runway axis, and was kept at a height less than 36 ft during at least 20 seconds, and then lost additional height without any increase of engine power until it touched down and hit the sentry box.

This maneuver was not a part of the flight test plan that was discussed during the pre-flight briefing.

The following factors could have had an influence in the event:

- The decision to carry out a test maneuver of the «DON'T SINK» warning of the GPWS at very low height.
- The lack of reaction of the crew for 56 seconds while the aircraft was deviating from the runway axis and eventually losing height over the ground.
- The reported sighting of birds by the pilot in command.

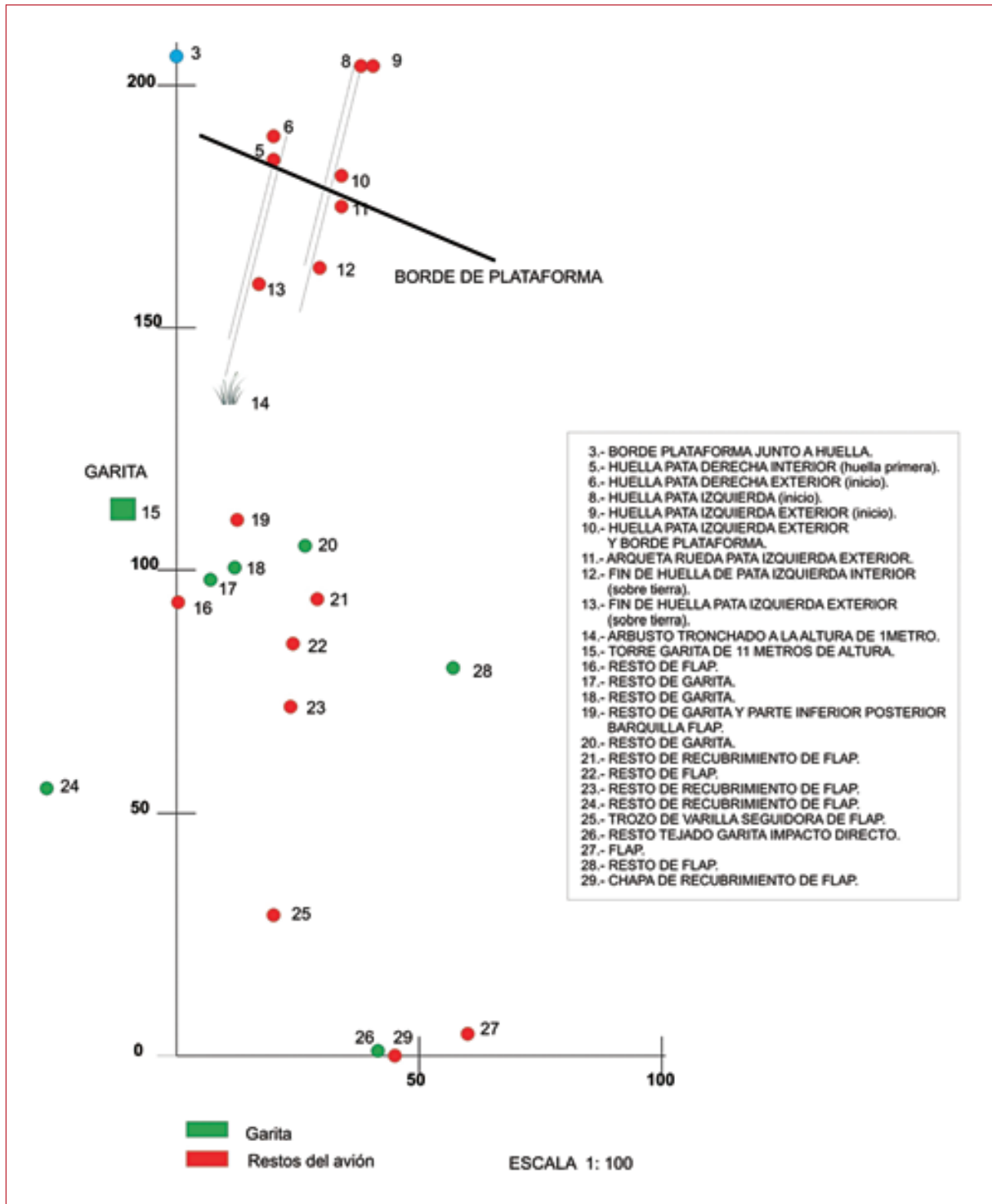
#### 4. SAFETY RECOMMENDATIONS

- REC 01/04.** It is recommended to the operator that their plans for flight test after maintenance are updated with the latest documents issued by the manufacturer for this kind of flights.
- REC 02/04.** It is recommended to the operator that a procedure for the appointment of flight crews to test flights is established, in a way that a minimum level of experience and qualifications is set forth.
- REC 03/04.** It is recommended to the operator that clear roles and responsibilities over the items to be tested are established in the procedure for the conducting of flight test after maintenance.



# APPENDICES

**APPENDIX A**  
**Debris diagram and tracks**  
**over the terrain**



**APPENDIX B**  
**Photos of damaged parts of the aircraft**



*General view of the tracks over the apron*



*Detail of the tracks and lights well*



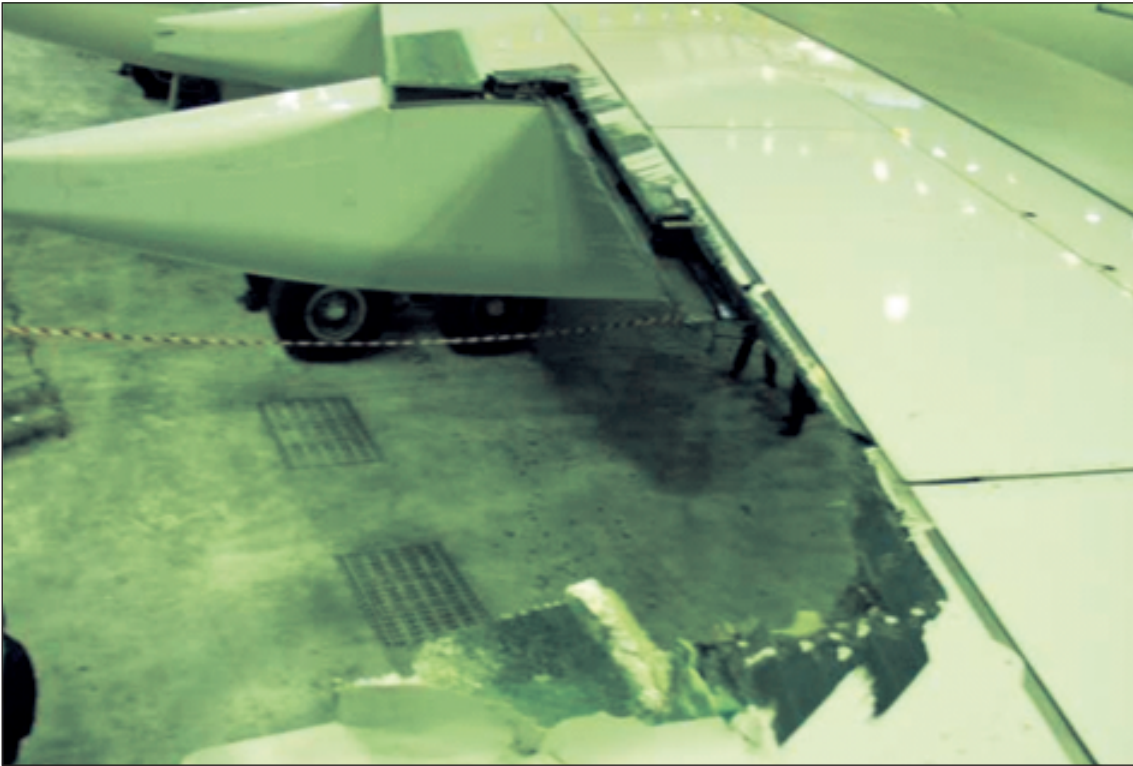


*Debris of the RH outboard flap*



*Wreckage of the mobile support of the flap*





*Flap exterior derecho. Vista superior*



*Flap exterior derecho. Vista inferior*

## **APPENDIX C**

### **FDR data and trajectory**



