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Interim Report A-019/2008

Accident involving
a PILATUS PC-6A
TURBO-PORTER aircraft,
registration EC-JXH,
in Lillo (Toledo)
on 30 May 2008



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DE TRANSPORTES

COMISIÓN DE INVESTIGACIÓN
DE ACCIDENTES E INCIDENTES
DE AVIACIÓN CIVIL

Edita: Centro de Publicaciones
Secretaría General Técnica
Ministerio de Fomento ©

NIPO:
Depósito legal: M. 23.129-2003
Imprime: Diseño Gráfico AM2000

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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 of the event and its causes and consequences.

In accordance with the provisions of Law 21/2003 and pursuant to Annex 13 of the International Civil Aviation Convention, the investigation is of exclusively a technical nature, and its objective is not the assignment of blame or liability. The investigation was 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 was originally issued in Spanish. This English translation is provided for information purposes only.

Table of contents

Abbreviations	vi
Synopsis	vii
1. Factual information	1
1.1. History of the flight	1
1.2. Injuries to persons	3
1.3. Damage to aircraft	3
1.4. Other damage	3
1.5. Personnel information	4
1.6. Aircraft information	4
1.6.1. Aircraft characteristics	4
1.6.2. Weight and balance	5
1.7. Meteorological information	6
1.8. Aids to navigation	8
1.9. Communications	8
1.10. Aerodrome information	9
1.11. Flight recorders	9
1.12. Wreckage and impact information	9
1.12.1. Main wreckage	9
1.12.2. Left wing	10
1.12.3. Horizontal stabilizer	11
1.13. Medical and pathological information	12
1.14. Fire	12
1.15. Survival aspects	12
1.16. Tests and research	13
1.17. Organizational and management information	13
1.18. Additional information	13
1.19. Useful or effective investigation techniques	13
2. Progress of investigation	15
Appendices	17
Appendix A. Wreckage distribution pattern	19

Abbreviations

00°	Geographical degree
00 °C	Degrees centigrade
AEMET	Spain's national weather service
CPL(A)	Commercial pilot license
ft	Foot
h	Hour(s)
hPa	Hectopascals
kg	Kilogram(s)
km	Kilometer(s)
kt	Knot(s)
LELT	Lillo (Toledo) aerodrome designator
LECM	Madrid Control Center
m	Meter(s)
m/s	Meters per second
M.A.C.	Mean Aerodynamic Chord
N	North
NM	Nautical miles
NE	Northeast
s	Second
SE	Southeast
SSW-NE	South-Southwest-Northeast
TOW	Takeoff weight
UTC	Universal Coordinated Time
VFR	Visual Flight Rules
VOR	Very High Frequency Omnidirectional Range
W	West
ZLW	Zero fuel weight

Synopsis

Owner and operator:	SKY DIVE
Aircraft:	Pilatus PC-6A Turbo-Porter
Date and time of accident:	30 May 2009; 15:45 (local time) ¹
Site of accident:	Lillo (Toledo)
Persons onboard and injuries:	Two (2) fatalities (pilot and passenger), four (4) passengers injured and five (5) passengers uninjured
Type of flight:	Aerial Work – Commercial – Parachute drop
Date of approval:	24 March 2010

Event summary

The airplane had taken off from runway 30 at the Lillo (Toledo) aerodrome for a local parachute drop. Onboard the aircraft were the pilot and ten parachutists, six of whom consisted of instructor-student pairs doing tandem jumps.

When they were at an altitude of 4000 m and after the alarm bell had sounded indicating that they were within two minutes of the drop site, the left wing fractured and detached. As a result, the airplane started to fall to the ground. Nine of the parachutists were ejected out and were able to open their parachutes at a sufficient enough altitude to land normally.

The pilot and one of the parachutists could not exit the aircraft and were killed on impact.

The airplane fell to the ground 4.5 km away from the aerodrome. It caught on fire after the impact. The fire destroyed the area between the firewall and the aft end of the passenger cabin.

Several components, including the detached wing and its control surfaces, as well as part of the horizontal stabilizer, were found between 1.5 km and 2.5 km to the northeast of the main crash site.

¹ All times in this report are local. To obtain UTC, subtract two hours from local time.

1. FACTUAL INFORMATION

1.1. History of the flight

The airplane, a PILATUS PC-6A TURBO-PORTER operated by Skydive Lillo, based at the Lillo (Toledo) aerodrome, had been performing parachute drops since the early daylight hours. In the afternoon it had been scheduled to take off at 15:00, although it actually departed at around 15:20.

Onboard were the pilot, five jump instructors who worked for the operator, three passengers who had never jumped before and two other parachutists who were not affiliated with the company. The three passengers were going to do a tandem jump with three of the instructors. The other two instructors jumped with cameras to videotape two of the tandem jumps.

The airplane took off from runway 30 and, as reported by the occupants, proceeded to climb normally. However, seconds after the alarm sounded to notify the parachutists that they were within two minutes of the drop area, the pilot announced that he was going to make a turn. It was then that, while at an altitude of 4,500 m, the airplane was subjected to a strong and instantaneous negative acceleration that pushed the occupants against the ceiling of the aircraft. No sooner had they returned to their normal positions when the left wing broke 5.75 m from the wing tip and detached. This resulted in the right wing rising, inverting the aircraft and causing it to start falling uncontrollably while spinning clockwise (as seen from above).

During the fall, the swing doors on the left side of the fuselage, which had been closed, opened. The rotating motion of the airplane about its axis expelled eight of the parachutists via the opening, including the three pairs jumping in tandem. An additional



Figure 1. Photograph of aircraft at crash site

The pilot and one of the instructors were unable to exit the aircraft under their own power, nor were they ejected by the rotation. They were killed on impact and their bodies charred in the subsequent fire.

Four of the occupants suffered various injuries (three serious and one slight) and the other five were uninjured.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Others
Fatal	1	1	2	
Serious		3	3	
Minor		1	1	Not applicable
None		5	5	Not applicable
TOTAL	1	10	11	

1.3. Damage to aircraft

The airplane was destroyed as a result of the impact and subsequent fire. The right wing broke in two places upon impacting the ground. The part closer to the root remained attached to the airplane, along with the inboard flap, and was affected by the fire. The other part, to which were attached the ailerons and the outboard flap, detached and fell to the left of the main wreckage, where it was unaffected by the fire. The left wing broke up in flight into two pieces. The one closest to the root also remained attached to the fuselage along with the inboard flap and was affected by the fire after impact. The other piece separated in flight and was found 1.5 km to the northeast of the main wreckage. The outboard flap and the aileron were found separate from the wing, 2 km and 2.5 km away, respectively, also northeast of the main wreckage.

The vertical stabilizer and the rudder were mostly unaffected and remained attached to the airplane. Also attached to these components was a portion of the right elevator, which was severely damaged. The horizontal stabilizer, the left elevator and part of the right elevator detached and were found to the north of the airplane, in the same area as the remains of the left wing.

The engine was not affected by the fire but exhibited significant structural damage. All four blades on the propeller were bent to varying degrees.

1.4. Other damage

There was no damage to surrounding areas.

1.5. Personnel information

The pilot, 38, held a valid Commercial Pilot License CPL(A) and medical certificate. He had a firefighting rating and was also rated on the PILATUS PC6. His total experience was 1,100 h, 150 of which had been on the type.

In December 2007, he had taken a six-hour familiarization course on the PILATUS PC-6. From January to February 2008, he had flown for another operator also performing parachute drops from the Ocaña aerodrome, accumulating 35 hours on that airplane model. He had been working for the operator since February 2008 and had flown 110 h. Neither the parachuting instructors nor the passengers had any functions onboard the airplane during the flight.

1.6. Aircraft information

1.6.1. Aircraft characteristics

The aircraft was built in 1969 with serial number 700 and had a valid airworthiness certificate. It was equipped with a PRATT & WHITNEY PT6A-34 engine and a HARTZELL HC-D4N-3P/D9511F propeller.

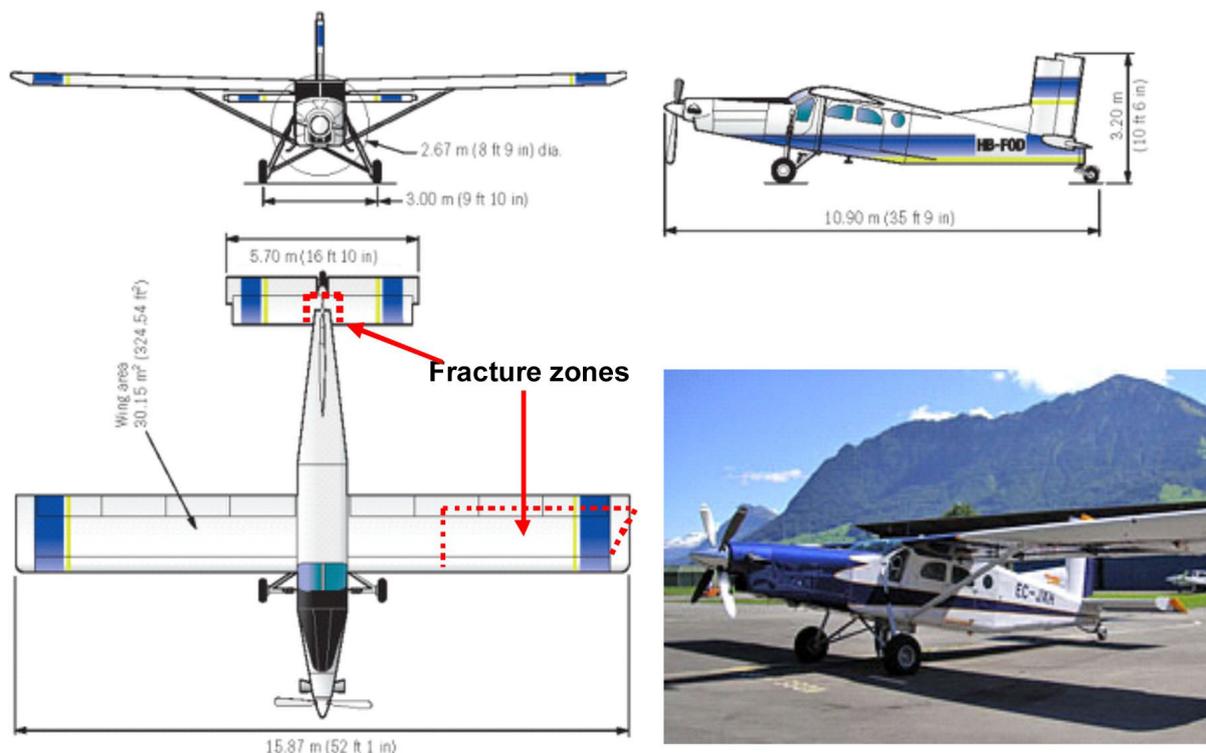


Figure 4. Views of the aircraft

It had a wingspan of 15.87 m and was 10.9 m long and 3.2 m high. Its maximum takeoff weight was 2,800 kg and its maximum landing weight was 2,660 kg.

Since manufacture, it had belonged to seven different owners and had accumulated 15,833 flight hours and a total of 26,931 landings. It had satisfactorily passed its last maintenance inspection on 15 April 2008 (100-h inspection).

1.6.2. Weight and balance

The weight and balance calculation was made as specified in the Flight Manual and using the information provided by the Operator with regard to the weight of the passengers and parachutes, and a fuel amount equivalent to half a tank.

Persons & Equipment	Wt. (kg)	Arm (m)	Moment (kg × m)
Empty airplane	1,376.5	3.340	4,597.51
Pilot	81.0	3.050	247.05
Passenger 1 + parachute	110.0	3.050	335.50
Passenger 2 + parachute	97.0	3.850	373.45
Passenger 3	68.0	3.850	261.80
Passenger 4 + parachute	68.0	4.570	310.76
Passenger 5 + parachute	110.0	5.280	580.80
Passenger 6 + parachute	100.0	5.600	560.00
Passenger 7	62.0	5.280	327.36
Passenger 8 + parachute	71.0	4.570	324.47
Passenger 9	77.0	3.850	296.45
Passenger 10 + parachute	88.0	3.850	338.8
Oil	13.0	0.960	12.48
Zero fuel weight (ZLW)	2,321.5		1
Fuel	259.2	3.93	1,018.70
Takeoff weight (TOW)	2,580.7		9,594

The calculations were made assuming an individual parachute weight of 10 kg, and a tandem parachute weight of 20 kg.

According to the above table, the center of gravity would be 3.47 m away³ from the reference line, that is, at 37.8% M.A.C.⁴, and therefore within the approved area on the weight and balance diagram (see Figure 5).

³ C.G. = Total moment/Takeoff weight = 9,594.11/2,567.7 = 3.73.

⁴ M.A.C.: Mean Aerodynamic Chord. The % MAC is calculated using the formula ((C.G. – 3)/1.9) × 100.

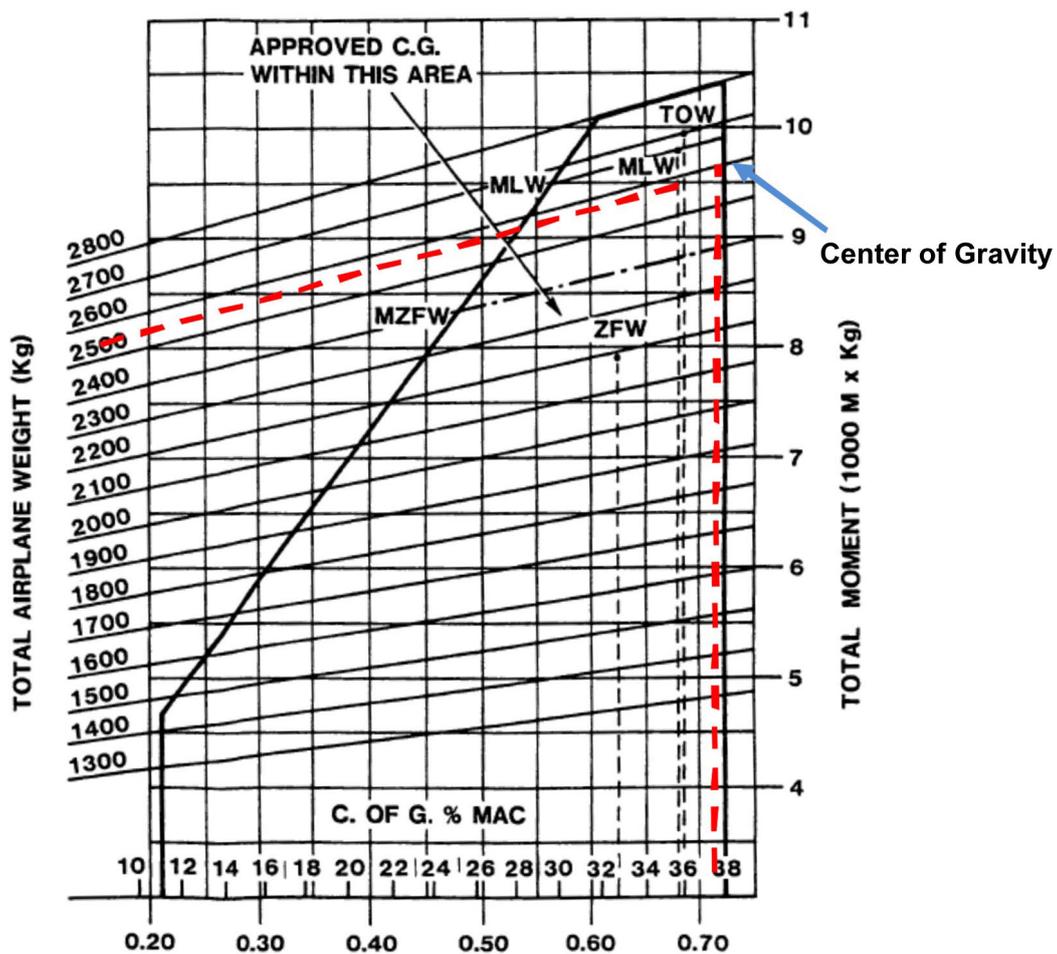


Figure 5. Diagram for calculating position of Center of Gravity

1.7. Meteorological information

Spain's national weather service (AEMET) reported that on the day of the accident, mid-level weather in the Iberian Peninsula at 15:50 was dominated by a cold low pressure area centered to the west of Portugal (-20°C and 500 hPa at an altitude of 5,600 m) that stretched over the entire western peninsula. In the northwest of the peninsula, the temperature at 3,000 m was -4°C .

The atmosphere was unstable in Avila, Toledo, north of Ciudad Real and south of Madrid with numerous cumulus and stratocumulus clouds. Mixed in were convective-type clouds that were moving from SSW to NE, reaching altitudes in excess of 4,500 m and over 10,000 m in some places.

At 15:40, at coordinates $39^{\circ} 45' 25.56'' \text{N} - 3^{\circ} 18' 23.1'' \text{W}$ (site of the accident), the most likely weather at 4,000 m was mostly cloudy skies with cumuliform clouds. Between 15:20 and 15:30 a storm cell with moderate and increasing convective activity,

which was to the SE, started moving over the accident site. The center of this cell, which was moving to the NE, was over the accident site and surrounding areas by 15:50. During this interval, between 15:30 and 15:50, the cell continued to affect the accident site. At some points along the cell the cloud tops were over 10,000 m high, and over 5,000 m high at the exact location of the accident. No lightning strikes in the vicinity of the accident site were recorded during this time period.

In light of this situation, moderate to strong vertical drafts could have been present in the area, along with precipitation of a convective nature (rain and thunderstorms). The temperature in the area at the time was probably around -10°C .

The reflectivity and Eco Top images in Figure 3 show, respectively, the type of precipitation in the area at the time of the accident (light) and the altitude of the clouds (between 5 and 10 km).

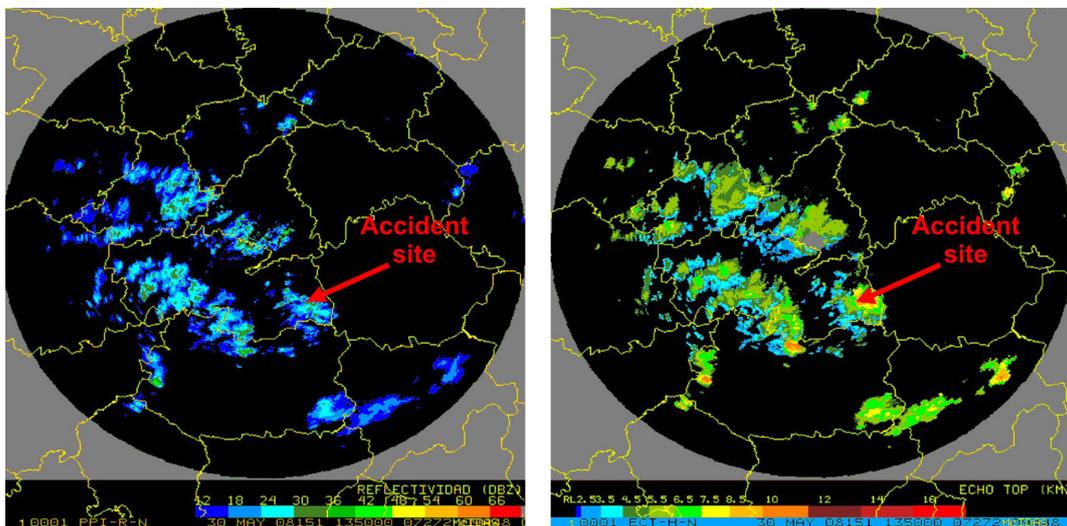


Figure 6. Reflectivity and Eco Top images at 15:50

One of the parachutists was recording during the climb on a camera mounted on his helmet (Figure 7). Later, during the fall, the camera turned on inadvertently when he hit his head as he was ejected from the airplane, so part of the fall was recorded (Figures 8 and 9). The footage shows the atmospheric situation described above, with abundant clouds and precipitation.



Figure 7. View from inside

Two of the passengers who were making their first tandem jumps reported that



Figure 8. Photograph during fall



Figure 9. Photograph during fall

during the climb, they could see numerous clouds around them from their respective positions inside the airplane.

Several other accounts were obtained during the investigation from instructors and pilots engaged in various activities at the Ocaña aerodrome (located 15 NM north of the accident site), where two flights that were heading in the direction of the accident site had to be cancelled when a storm located over the eventual crash site was noted to be in their path.

1.8. Aids to navigation

The flight took place in VFR conditions.

1.9. Communications

The accident aircraft (EC-JXH) made contact with the Madrid ATC center (LECM), and had the following conversation:

Time	Station	Statement
15:38:16	EC-JXH	«Madrid Control good afternoon again EC-JXH»
15:38:21	LECM	«Good afternoon EC-JXH squawk seven zero zero three»
15:38:25	EC-JXH	«Squawk seven zero zero three EC-JXH»
15:52:18	LECM	«¿EC-JXH Madrid?»
15:52:28	LECM	«¿EC-XH Madrid?»

1.10. Aerodrome information

The aerodrome out of which it operated, designated LEIT, is classified as uncontrolled. It is located 1 km southwest of Lillo (Toledo) and 10 NM southeast of the Villatobas VOR.

It has a 750-m long, 18-m wide asphalt runway in a 12/30 orientation. It is at an elevation of 681 m, and its reference point is at coordinates 39° 43' 2" N - 3° 19' 15.9" W.

1.11. Flight recorders

The aircraft was not equipped with flight recorders nor was it required to by regulations given its characteristics.

1.12. Wreckage and impact information

1.12.1. Main wreckage

The airplane fell vertically and impacted in an inverted position at coordinates 39° 45' 25.56" N – 3° 18' 23.1" W, at an elevation of 688 m. Its longitudinal axis was at a 45° angle with respect to magnetic north. There were no drag marks. A part of the left wing spanning two thirds of its total length was missing. The part of the wing that remained attached to the fuselage had burned along with the main wreckage. A 1.10-m long section of the brace was still anchored. The inboard flap remained attached to the part of the wing that did not detach, and it was also charred.

The right wing broke on impact and detached. It was found situated parallel to the airplane's longitudinal axis. The wing segment that remained attached to the fuselage was severely affected by the fire and only portions of the top surface remained. The fuel cap was in its place and closed. The part that had detached measured 5.5 m in length. A 1.76-m long part of the strut was still attached, and a 0.47-m long section remained joined to the fuselage. The deformations present indicated that the wing had broken on impact with the ground due to a bending stress from the top surface to the bottom.

The engine was in one piece and without any significant apparent damage. All four propeller blades were bent to varying degrees, with the tips pointing backward.

The fire had destroyed the airplane from the firewall (Station 1) to the aft part of the passenger cabin (Station 8). There was continuity and tension in the control surface cables until the last section, in the tail cone, where they had snapped from the force of the impact.

In the tail section, the vertical stabilizer and the rudder were in one piece. There was evidence of significant compression damage to the latter. The vertical stabilizer trim tab had detached and was found next to the tail section.

Only the main edge on the right side of the horizontal stabilizer was still attached. It was heavily damaged, having been bent toward the left side of the fuselage. . The rest (the right side and the other segment of the left side) was found elsewhere.

The pilot's and copilot's doors, which were permanently closed, were severely affected by the fire. Of the other doors, only the front door of the two swing doors on the left side remained (both had been closed). The other swing door and the sliding door on the right side were charred in the fire.

The emergency parachute of the passenger who perished had deployed because the device was designed to activate automatically upon reaching a descent speed above 35 m/s or an altitude of 225 m.

1.12.2. *Left wing*

The part that detached from the left wing was found alongside the Lillo-Villatobas road, in the segment that is known as the Cerrotraviesa trail, at coordinates 39° 46' 0.18" N – 3° 17' 10.8" W and an elevation of 680 m. It was oriented from east (part near the tip) to west (part near the root), and resting on its top surface. It was 5.75-m long measured along the spar closest to the leading edge. A 0.85-m long segment of the strut was still attached to it. The force of the impact had caused it to bend along its length such that it was convex along the top and concave along the bottom.

The rivets had pulled out of the top skin closest to the root.

There were two dents on the leading edge. The wing tip was torn and a portion of the trailing edge had detached and come to rest in a separate area from the rest of the wing. Three of the four control surfaces were found. The outboard aileron was not recovered. The inboard aileron, which was only slightly damaged, was the one component that was farthest away from the main airplane wreckage. Specifically, it was found alongside the road that goes from Lillo to Santa Cruz de la Zarza, at coordinates 39° 46' 33.38" N – 3° 17' 17.67" W and an elevation of 692 m. Its fittings were bent. The outboard flap was found on the same road as the wing, at coordinates 39° 46' 6,36" N – 3° 17' 29.58" W and an elevation of 682 m. There were dents at either end of the leading edge.

The left wing tip and a small part of the tail assembly were found together alongside the La Guardia-Corral de Almaguer road, at coordinates 39° 46' 16.8" N – 3° 17' 30.24" W and an elevation of 690 m.



Figure 10. Photograph of left wing

1.12.3. *Horizontal stabilizer*

Like the left wing, the horizontal stabilizer was also found near the Cerrotraviesa trail, at coordinates $39^{\circ} 45' 48.66''$ N – $3^{\circ} 17' 47.58''$ W and an elevation of 700 m. It was bent at the center in a U-shape (see Figure 11) and ripped from its fittings at the center. The left side was heavily damaged. It was missing the piece that had remained



Figure 11. Photograph of the horizontal stabilizer

attached to the main wreckage. A part of the right side of the leading edge was found alongside the La Guardia-Corral de Almaguer road, at coordinates 39° 46' 16.2" N – 3° 17' 26.64" W and an elevation of 690 m.

A fragment from part of the left elevator closest to the tip was found halfway between the left wing and the horizontal stabilizer, also near the Cerrotraviesa trail, at coordinates 39° 45' 53.22" N – 3° 17' 44.7" W and an elevation of 700 m. It had a significant tear with loss of material and there was a heavy impact mark on its top surface.

1.13. Medical and pathological information

The pilot and one of the passengers died on impact and their bodies remained in the aircraft wreckage, as a result of which they were charred in the subsequent fire.

The students who were jumping in tandem were seriously injured and had to be hospitalized. One of them had a spinal injury, another damaged the ligaments in one of his knees, and the third suffered neck and hipbone injuries which required surgery.

One of the instructors was slightly injured and was hospitalized until the next day. The other four instructors and one parachutist who was not working for the operator were uninjured, though they were examined by emergency services personnel who responded to the scene of the accident.

1.14. Fire

After the impact with the ground, a fire broke out that only affected the aircraft, destroying the area from station 1 (firewall) to station 8 (forward part of the tail cone) of the fuselage. Also affected were those portions of the wing that had remained anchored to the structure.

Immediately after the aircraft impacted the ground, it began to rain, which started to douse the fire. A few minutes later several fire trucks based in Villacañas (Toledo) arrived on the scene and quickly managed to extinguish the fire.

The fire charred the bodies of the pilot and one of the passengers, which had remained trapped inside the wreckage.

1.15. Survival aspects

Non applicable.

1.16. Tests and research

The airplane wreckage is being analyzed in a laboratory so as to determine the origin and progression of the fractures found and to establish what caused part of its structure to collapse.

1.17. Organizational and management information

The jump activity was organized by the Lillo Parachuting Center, which also operated the aircraft. This center had been operating at the aerodrome since September 2000, though it did not purchase its first airplane until August 2001 (a Pilatus airplane, registration EC-IBY). The accident airplane was acquired by the company in August 2006. The operator had another airplane, a CESSNA CARAVAN 208 B, acquired in late 2007 or early 2008.

According to information provided by the company, it organizes between 30,000 and 35,000 jumps a year, about of which 4,000 are tandem jumps.

1.18. Additional information

Given the location of the runway, which is between the town and the hangars, which are to the north, and a lagoon at the south, the run for dropping the parachutists is generally made on a course of 300°, that is, from the town toward the hangars. The jump start point is indicated by the pilot.

Under normal wind conditions, the minimum separation between parachutists as they exit the airplane is about eight seconds. When winds aloft are high, the separation time in seconds is calculated by dividing the wind speed in knots by two.

Prior to the accident flight, the Operator employee who was controlling the airplane's flight from the ground stated that he requested to the pilot that the jump be made 0.5 NM north of the normal jump area due to an approaching storm from the south and which was then over Villacañas (11 km to the south).

Two of the passengers, who were making tandem jumps for the first time, stated noticing a certain urgency on the part of the Operator to start the flight due to the storm that was approaching from the south.

1.19. Useful or effective investigation techniques

No unconventional investigation techniques were used.

2. PROGRESS OF THE INVESTIGATION

The various components recovered from the airplane wreckage are being analyzed in the laboratory. These mainly include the left wing and the horizontal stabilizer. The aim is to determine on which component the fault that triggered the accident originated, the exact point where it started, the stress conditions to which said components were subjected and how the fractures progressed. The ultimate goal is to determine the causes of the failure.

Also being analyzed are the forces to which the aircraft may have been subjected as a result of meteorological conditions.

The intention is to establish whether there was any pre-existing damage to the airplane's structure or whether design loads were exceeded by the combination of a turning maneuver and a positive gust.

Another factor still being studied involves the operational aspects on the day of the accident and the factors that may have influenced the decision to proceed with the flight despite the adverse weather conditions.

APPENDICES

APPENDIX A

Wreckage distribution pattern



