CIAIAC

COMISIÓN DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES DE AVIACIÓN CIVIL

Report A-017/2003

Accident involving a Cessna P210N Centurion aircraft, registration PH-WVW, on 3 April 2003, in the vicinity of Oroquieta (Navarre)

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

Table of contents

Abbreviations

00°	Degrees
00° 00′ 00″	Degrees, minutes y seconds
00 °C	Degrees Celsius
A	Aircraft
ATC	Air Traffic Control
FAA	Federal Aviation Administration
FIR	Flight information region
FL	Flight level
ft	Feet
fpm	Feet per minute
g	Normal acceleration
GPS	Global positioning system
h	Hour(s)
hh:mm:ss	Hours:minutes:seconds
HP	Horse Power
hPa	Hectopascal
IFR	Instrumental flight rules
ILS	Instrumental landing system
ICAO	International Civil Aviation Organization
INTA	National Institute for Aerospace Technology
KIAS	Indicated Airspeed in knots
kg	Kilogram(s)
km	Kilometer(s)
kt	Knot(s)
lb	Pound(s)
m	Meter(s)
METAR	Meteorological report
MHz	Megahertz
MTOW	Maximun take off weight
N	North
NM	Nautical mile(s)
NNE	North North East
NNW	North North West
NTSB	National Transportation Safety Board
NOTAM	A notice distributed by means of telecommunication containing information concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to personnel concerned with flight operations
QNH	Altimeter sub-scale setting to make it to indicate the altitude of the airport above mean sea level during takeoff and landing
s	Second(s)
SIGMET	Significant meteorological information
STC	Supplemental type certificate
TAFOR	Trend airport forecast
UTC	Coordinated universal time
Va	Maneuvering speed
VFR	Visual flight rules
VHF	Very hight frequency
VNO	Maximum structural cruising speed
VOR/DME	Very high frequency omnidirectional radio range/Distance measure equipment
W	West

Synopsis

Owner and Operator:	Private
Aircraft:	CESSNA P210N Centurion
Date and time of accident:	3 April 2003, 13:37 local time
Place of accident:	250 m south of the town of Oroquieta (Navarre)
Persons aboard:	2
Type of flight:	Private
Date of approval:	25 April 2007

Overview of the accident

On 3-04-2003, while flying from Malaga Airport to San Sebastian Airport, a Cessna P210N Centurion, registration PH-WVW, experienced an in-flight structural failure involving the detachment of essential major components, including the left wing. This failure resulted in the aircraft falling and impacting the ground at great speed.

As a result of the impact, both occupants died and the aircraft was destroyed.

1. FACTUAL INFORMATION

1.1. History of the flight

The flight plan for the Cessna P210N Centurion, registration PH-WVW, for 3 April 2003 entailed a general aviation IFR flight of a private, non-commercial nature with two persons aboard. The flight was between the Malaga and San Sebastian airports as part of returning the aircraft to Amsterdam. On its way to Malaga the previous 28 March, the aircraft had stayed overnight in San Sebastian, and possibly refueled there as well.

The flight plan indicated a 10:00 (local) takeoff time, used the letters in the aircraft's registration as the call sign, specified that the aircraft had standard operating communication and navigation instruments and a fuel range of 6 hours and 22 minutes. The alternative airport was Biarritz (LFBZ).

The airspeed estimated in the flight plan was 180 kt at a flight level of FL170, equivalent to 17,000 ft. The estimated time to the destination was 2 hours and 38 minutes.

The aircraft received takeoff clearance at 09:34:36 (local)[1].

The flight was tracked by air traffic control radar and the pilot established normal radio contact with control centers along the route throughout the flight. The aircraft's last radio contact was with the control tower at San Sebastian Airport (LESO), in answer to the tower's call at 13:31:24. The last good radar fix was obtained at 13:35:31.

The accident took place in the vicinity of Oroquieta, a town some 25 km NNW of Pamplona (Navarre) at an altitude of 600 m. The main wreckage was around 250 m south of the town, at geographical coordinates 43° 00′ 37″ N/1° 45′ 19″ W (see Figure A-1 in Appendix A). The aircraft's impact with the ground was very violent and resulted in the death of the two occupants.

1.2. Injuries to persons

Injuries	Crew	Passengers	Total in the aircraft	Other
Fatal	1	1	2	
Serious				
Minor				Not applicable
None				Not applicable
TOTAL	1	1	2	

[1] Unless otherwise indicated, all times are local. It is necessary to subtract two hours to obtain the Coordinated Universal Time (UTC).

1.3. Damage to aircraft

The aircraft was completely destroyed, its wreckage scattered in a large number of pieces on the ground.

1.4. Other damage

No other damage was noted.

1.5. Personnel information

1.5.1. *Pilot at the controls of the aircraft*

Age/Gender:	55/Male
Nationality:	Dutch
License:	Private pilot's license (A)
Number:	NL.2002.40502.2b323
Date issued:	4-01-2001
License:	Commercial pilot's license (A)
Date issued:	30-09-2002
Certificate of competency:	— Renewal date: Unknown — Expiration date: 12-08-2004
Ratings:	— Single engine land since 4-01-2001 — Instrument since 30-09-2002, valid until 25-11-2003 — Radiotelephone operator (international)
Total flying hours:	497 h
Hours on the type:	Unknown
Date of last flight before accident:	29-03-2003
Restrictions:	— Must use corrective lenses — Medically fit for IFR flights

1.6. Aircraft information

The Cessna 210 is a single-engine, high-wing aircraft whose first models used wing struts. Starting with the higher-fuel-capacity 210G model, the strutted wings were replaced with cantilevered wings.

The P before the model number means the aircraft was pressurized, the P210N being one of the first such models. The model's configuration and dimensions are shown in Figure A-2, taken from the aircraft's Flight Manual.

In addition, the accident aircraft was equipped with wing tip fuel tanks in accordance with Supplementary Type Certificate (STC) SA4300WE issued by the Federal Aviation Administration (FAA) on 16 January 1984. These tanks increase the aircraft's wingspan by 66 cm and allow for an additional fuel load of 33 US gallons (124.9 liters), 32.5 gallons (122 liters) of which are usable for a total fuel capacity of 122 gallons. These tanks were installed on the aircraft in accordance with the instructions in the above mentioned STC during an inspection on 26 June 2002.

According to the flight manual, the velocity not to exceed (Vne) is 200 KIAS. The maximum structural cruising speed (VNO) 167 KIAS. Do not exceed this speed except in smooth air, and then only with caution.

The maneuvering speed (Va) is a function of the aircraft's weight, its value being 130 KIAS for a weight of 4,000 lb, 119 KIAS for 3,350 lb and 106 KIAS for 2,700 lb. Full deflections or sudden movements of the flight controls should not be made above this speed.

The positive and negative limits for the maximum load factor are 3.8 g and –1.52 g. Flying in known or forecast icing conditions was not allowed, although the airplane did have a TKS system installed which offered limited anti-icing protection (through the use of liquid antifreeze in the wing, stabilizers, propeller and windshield, as stated in STC SA00172WI).

1.6.1. *Frame*

Manufacturer:	CESSNA
Model:	P210 Centurion
Serial number:	P-210-00426
Registration:	PH-WVW
MTOW:	4,000 lb (1,814.37 kg)
Owner:	Bilahn B.V.
Operator:	Bilahn B.V.

The aircraft's empty weight, as recorded on 21-06-02, was 2709 lb (1228.78 kg). The aircraft's weight at the time of the accident can be estimated as follows:

— Empty weight:	2,709 lb
— Pasengers:	300 lb
— Luggage:	40 lb
— Fuel:	300 lb
Total:	3,349 lb

1.6.2. *Airworthiness certificate*

Number:	6106
Type:	Normal
Issue date:	23-07-2002
Expiration date:	24-07-2003

1.6.3. *Aircraft maintenance record*

Total flying hours:	2,831 h, 16 minutes on 29-08-02
Last 100-hr inspection:	10-12-2002
Hours on last 50-hr inspection:	2,831 h, 16 minutes on 29-08-02
Last major inspection:	2,782 h, 29 minutes on 26-06-02

On 26-06-02 an inspection and overhaul of the aircraft was performed following an emergency landing due to a fuel problem. After this incident, all the major structural components (wings, fuselage, landing gear and tail) and the engine-propeller assembly were disassembled, inspected and repaired.

Each of these components was sent to specialized companies, the propeller for an overhaul and the engine for a complete disassembly and dimensional check of its components. The crankshaft was changed out due to excessive deformation, along with the six pistons. All necessary repairs were also made.

The following structural elements were repaired or replaced:

Right wing: Renewed of various leading edges at the ribs, parts of the upper and lower skin, and doubler and stringer sections. One stringer was replaced. Parts of the right aileron were also replaced (rear spar, one rib and sections of the skin) and part of the skin on the trailing edge of the right flap.

Left wing: the repairs were not as extensive as on the right wing. Parts of the lower outboard skin, upper outboard skin and lower inboard skin were rerewed.

Tail: two attachment brackets on the horizontal stabilizer were replaced in compliance with Airworthiness Directive BLA2002-052.

The landing gear fittings and portions of the fuselage's bulkhead firewall were also replaced or repaired.

Previously, on 19-2-1999, the aircraft had also been repaired following the untimely retraction of the landing gear.

Both repairs and inspections mentioned above were made by duly authorized companies.

1.6.4. *Engine*

Manufacturer:	Teledyne Continental
Model:	TSIO-520-P
Power:	285 HP
Serial number:	278595R
Total hours:	1,001 h and 21 minutes on 29-06-02 [2]

1.6.5. *Propeller*

Manufacturer:	McCauley
Model:	D3A34C402/90DFA-10
Serial number:	7910345

The only relevant information for the propeller indicates that on the 50-hr inspection made on 24 July 2000, the propeller had 164 hours and 24 minutes of flying time and that it was overhauled on 26-7-2002, as previously indicated.

1.7. Meteorological information

1.7.1. *Meteorological summary for the day of the accident*

a) General situation

There were intense low-level winds from the north over the northeast quarter of the Iberian Peninsula and the Balearic Islands, which was between a powerful high-pressure system centered southeast of Ireland and a low-pressure area over Corsica and Sardinia. There was, therefore, an area of cold air advection in the middle of the Iberian Peninsula channeling moisture into the Bay of Biscay and the upper Ebro River basin.

The most notable weather feature on that day was the existence of strong winds from the north that increased in intensity with altitude.

[2] As previously indicated, the engine was overhauled and its main components replaced on 26-06-02. This inspection and repair was made when the engine had logged 952 h and 24 minutes of operation.

b) 13:30 METAR for Pamplona Airport

— Winds:	From 360° at 25 kt gusting up to 35 kt
— Visibility:	10 km or more
— Clouds:	Scattered at 5,600 ft
— Temperature:	8 °C
— Dew point:	–1 °C
— QNH:	1,020

c) 13:30 METAR for San Sebastian Airport

— Winds:	From 330° to 60°, at 14 kt gusting up to 25 kt
— Visibility:	10 km or more
— Clouds:	Scattered at 4,700 ft
— Temperature:	11 °C
— Dew point:	0 °C
— QNH:	1,024

1.7.2. *Conditions in the area of the accident*

The weather forecast was for strong or very strong northerly winds with strong gusts resulting in heavy turbulence at the aircraft's flight level in the area of the accident. Between 800 and 700 hPa (1,960 to 3,120 m), the wind was shifting from NNW to NNE, going from 30 to 65 kt, which would have led to strong wind shear conditions. Temperatures were low with freezing levels above 1,240 m.

These conditions were generally corroborated by the eyewitnesses and residents that could be located in the area, but no information from other flights in the vicinity was available.

1.7.3. *Forecasts*

According to information provided, the handling company that serviced the aircraft at Malaga Airport picked up the 08:00 wind charts at the airport's weather office at 07:24.

This company usually provides pilots not only with wind charts, but with METARs and TAFORs for origin, destination and alternative airports, as well as NOTAMs, etc.

Figure A-3 shows the wind and temperature charts forecast for Spain at flight levels 050, 100, 180 and 300. These cover the planned and actual flight levels for the accident aircraft. The forecasts were valid until 08:00 h and, in comparison with earlier forecasts, showed a tendency for winds to diminish in intensity while maintaining their direction.

The maps show that for 08:00, winds near the takeoff airport in Malaga were forecast at 65 kt at FL180, increasing along the planned route to 115 kt in San Sebastian. At FL100, 45 and 60 kt winds were expected for both areas, respectively.

The significant weather chart for 06:00 UTC, shown in Figure A-4, shows two clearly separate areas. The first went from Malaga to the sierra north of Madrid, and the second extended from the sierra to beyond the destination airport. In the first, the forecast was for clear skies and no significant weather phenomena. For the second zone the forecast was not as benign, and called for cloudy skies (5-7 oktas) with a cloud base between 3,000 and 4,000 ft and cloud tops between 8,000 and 9,000 ft, as well as rain or snow storms, mountain obscuration, moderate ice formation on aircraft between 4,000 and 7,000 ft and a freezing level at 2000 feet. North of the 38° N parallel and east of the 5° W meridian, the forecast called for surface winds from the north between 30 and 45 kt.

Compared with previous forecasts, the tendency was for the weather over the accident site to improve, with diminishing winds and a shift north of the area in which aircraft were prone to ice formation, along with an increase in the freezing level.

1.8. Aids to navigation

The aircraft was equipped with the navigation systems required for IFR flights, including VOR/ILS receivers and a GPS system. The aircraft also had a Mode A/C transponder and an automatic pilot.

The intended route according to the flight plan was LOJAS - BAILÉN - CASTEJÓN - BARAHONA - PAMPLONA - SAN SEBASTIÁN. The route's total length was 337 NM, well within the fuel range and duration forecast in the plan.

The path followed by the aircraft practically matched the one in the flight plan and is shown in red in Figure A-5 for the area associated with the «Lower airspace radionavigation Chart». The path was determined by using the radar track for the flight as supplied by air traffic control services after 12:47:12, and from communications with the aircraft before that time. The track shows that the aircraft, with transponder code 2632, followed the planned route throughout the flight, save for authorized deviations, the most significant of these being that the flight level was maintained at FL100 for most of the flight, as requested by the pilot due to strong winds at higher altitudes.

Figure B-1 lists the groundspeed, flight level and geographical position over time, every five seconds, as recorded by radar from 13:31:21 until radar track was lost. This interval is the most relevant since it encompasses the moments prior to and during the accident. As seen on the table, starting at 13:35:21 the radar data show constant values for flight level (FL073) and groundspeed (111 kt), while the latitude and longitude keep changing until 13:35:41. Radar system information confirmed that these last two positions, corresponding to 13:35:36 and 13:35:41, were produced by the radar's inertial source and may therefore be invalid.

The values in the table in Figure B-1 were used to generate Figure B-2, which represents the variations with time for groundspeed and flight level during the period in question, and Figure B-3, which shows the geographical coordinates for the aircraft's track during the same interval.

In both figures the most important points have been identified with the same capital letter, along with the time of their occurrence in minutes and seconds.

1.9. Communications

The aircraft had a dual VHF communications system as required for IFR flights. The equipment was integrated with the navigation systems.

The available data show that the pilot successively contacted the various controlling agencies for the airspace through which he was flying, informing them of his position and requesting authorization for any maneuvers. At no time did he mention any emergencies or equipment malfunctions.

The aircraft's first radio contact was with ground control at Malaga Airport at 09:26:47, requesting permission to taxi. The aircraft was cleared for takeoff at 09:34:36, and 7 minutes and 15 seconds later the pilot requested a change in flight level from the FL180 called for in the flight plan to FL100 due to the existence of strong winds at higher levels.

The aircraft's last radio contact was with the tower at San Sebastian Airport to acknowledge both the weather data for the airport and the authorization he had received at 13:31:24 to proceed to the airport at 5,000 ft. This communication is estimated to have ended at 13:31:51.

The aircraft did not answer the succeeding calls from San Sebastian control made after 13:41:00, nor the ones made later by Madrid control. As informed by the latter, at 13:42:40 there was no longer any radar response for the code 2632 the aircraft had been using.

1.10. Aerodrome information

Not applicable to this accident.

1.11. Flight recorders

The aircraft was not equipped with a flight data recorder or a cockpit voice recorder. Neither recorder was required by the relevant aviation regulations.

1.12. Wreckage and impact information

1.12.1. *Location of the wreckage*

The remains of the aircraft were found fragmented into a large number of separate pieces scattered throughout the relatively flat area where the impact took place, with hills but without any appreciable orographic features. The wreckage was confined to a square 600 m on a side, the main wreckage being located in the northwest corner (see distribution diagram in Figure C-1 of Appendix C). This corner was some 250 m southeast of the town of Oroquieta.

The most significant parts of the wreckage, as identified by their number from Figure C-1, are as follows:

— The main wreckage (1 and Figure C-2) included the right wing, propeller and fuselage, except for the rear fuselage. Judging from the type of damage, these remains impacted the ground at great speed. The aircraft's longitudinal axis, including the nose, was aligned northwest-southeast. The aircraft fell to the ground and came to rest on its left side, resulting in the strong compression of the fuselage on that side. The landing gear was folded back. The central beam, to which the wings were attached, was buried over a meter into the ground on the side corresponding to the left wing. The right wing was still attached to the fuselage in a nearly vertical position. This wing had to be cut by firemen to get to the remains of the occupants inside the cockpit. Figure C-2 shows the arrangement of the main wreckage once the wing had been cut.
The engine was found next to the fuselage and attached to it by a few control cables. The mount broke on impact. The propeller was buried in the ground next to the engine but separate from it as its attaching elements were broken. Figure C-3 shows the propeller after it was recovered from where it had embedded itself. There were signs that the engine was turning and supplying power at the time of impact.
— The rear of the fuselage (4) with the vertical stabilizer almost intact and the rudder without the counterweight (Figure C-4.1), and with part of the left stabilizer (Figure C-4.2). Figures C-4.1 and 4.2 show different views of these components.
— The main part of the right stabilizer (7 and Figure C-5.1) with the right elevator and the tip of said stabilizer (8 and Figure 5.2). The stabilizer detached downward from the fuselage and the inboard part of the main section's leading edge showed signs of deformation in that direction.

— The outboard part of the left stabilizer (10). It also detached downward. The outboard hinge showed evidence of over-travel of the associated elevator in the up and down directions and the skin was cut and bent in the area near the hinges.
— The left wing was found in two pieces: the outboard section (11) with its wing tip tank and part of the aileron, and the inboard section with the flap (13 and Figure C-6). The deformation on the inboard left wing pointed to an upward detachment from the fuselage.

The layout and pattern of the wreckage, as well as its state, are indicative of an in-flight structural failure with the detachment of aerodynamic lift and stabilizing surfaces, especially of the left wing and the horizontal stabilizers. This led to the corresponding deviation of the aircraft toward the left side. Said deviation was attested to by eyewitnesses who saw the aircraft just before the accident.

The way the remains were scattered suggests that the height at which the structural failure and separation of components took place must have been appreciable. The final position of the wreckage on the ground was undoubtedly affected by the strong winds which caused the remains to be distributed mainly by their shape, mass and dimensions.

1.12.2. *Visual inspection of the wreckage*

The wreckage was taken to a hangar for a more detailed visual inspection. This inspection showed:

— The existence of permanent deformations on the right wing, near the break, symmetrical in location to those found on the left wing (Figure C-6). The waves from the buckling deformation of the main wing spar were oriented toward the outside and the upper surface. Unless these deformations resulted from the impact, which is a possibility, their presence suggests that a symmetrical overload state with a positive load factor (lift) was reached during the accident.
— The fractures on the horizontal stabilizer were indicative of static overload failure, with no signs of progressive or fatigue failure.
— There were no deformation waves toward the wing lower surface or signs of hammering at the tips of the ailerons on the right wing, thus ruling out the possibility of wing flutter.
— There was no corrosion protection on the aircraft's interior components, and some superficial corrosion was noted on the structure's inside surfaces. This lack of protection played no part in the fractures, however, since none of them, either on the wing or the stabilizers, showed any signs of corrosion.
— Lastly, the inspection did not reveal any evidence of a failure in the flight controls. As far as could be detected, given the condition of the wreckage, there was continuity in the cables and the parts that had become detached had done so due to tensile overload. An inspection of the fractured surfaces showed no signs of fatigue.

After the visual inspection, the remains of the left wing were sent to a specialized laboratory for a more detailed analysis.

1.13. Medical and pathological information

Since the accident took place near a populated area, medical services were quickly mobilized and arrived on the scene within 45 minutes. They could only confirm the death of the aircraft's occupants.

The day following the accident, forensic specialists concluded that a complete autopsy would be impossible given the state of the bodies. They proceeded to identify and examine the corpses, concluding that it was a case involving a violent death of an accidental nature (light aircraft accident according to the data) and that the cause of death had been multiple trauma.

1.14. Fire

There was no fire either before or after the accident.

1.15. Survival aspects

The damage and deformation evidenced by the aircraft, especially in the fuselage and the cockpit, indicate a high-speed impact with the ground. Under these conditions, the aircraft occupants had virtually no chance of surviving.

Given the proximity of the crash site to a populated area, rescue efforts were initiated quickly and first aid arrived on the scene almost immediately. As already stated, the rescue services found the occupants had already perished.

1.16. Tests and research

1.16.1. *Eyewitness statements*

Despite the proximity of the accident site to the town of Oroquieta and the fact that there were people who saw the aircraft in the air just before the accident, no one witnessed its impact with the ground as the crash site was obscured by either a hill or sloping terrain.

Accounts from two eyewitnesses match in that both stated the aircraft was flying rather high with the engine running when it turned to the left and suddenly started descending very rapidly. Both stated not seeing anything else after that point, hearing only as it impacted the ground.

One of them stated that the engine sounded as if it were over revving and reported seeing a flare or flash in the left wing before the turn and how, on proceeding to the crash site after hearing the impact, he could still see material falling slowly, material which he later saw was metallic plating.

1.16.2. *Information from the aircraft manufacturer*

An inspection of the wreckage in a hangar by experts from the manufacturer revealed that «the aircraft experienced an in-flight detachment of the horizontal stabilizers, followed by a segment of the left wing».

Other information provided by the manufacturer was that:

— It is not unusual in cases of structural failure for a loss of VHF and ATC signals. In most cases these losses result from a loss of coverage in the aircraft's antennas since, despite being located in places which usually guarantee the best coverage (on top of the cockpit and under the center of the fuselage between the landing gear legs), the aircraft can undergo violent movements in the break-up process that can place it in extreme attitudes, or even upside down,

— Maneuvers that can result in an in-flight wing detachment have been known to cause the aircraft occupants to black out instantly due to the high g-forces involved, and,

— Lastly that the P210N model, due to its very clean aerodynamic configuration, can rapidly increase its speed during significant attitude changes, such as when flying in strong or severe turbulence. In such cases, the stick has to be held firmly and any attempt at recovering the ship's attitude at airspeeds above the maneuvering speed must be done very carefully, without sudden maneuvers, so as to avoid structural overload.

1.16.3. *Analysis of the fractures on the left wing: conclusions*

As previously indicated, the remains of the left wing were sent to a specialized laboratory for a detailed analysis of the fracture mechanism. All of the left-wing fragments recovered from the crash site were sent, including fragments from the area surrounding the aileron hinge as well as fragments (wing-fuselage attachment fittings, lugs, pins and spar segments) which had remained attached to the fuselage.

For the analysis, the wing was divided into four fragments (Figure C-7):

— Two, labeled C and D, were parts of the main spar which had remained attached to the attachment fitting lugs on the fuselage and which were therefore found embedded in the ground along with the main wreckage, and
— The one labeled A in the figure corresponding to the inboard part of the wing, from the wing root to the section where the aileron starts, ribs 1 to 9, and fragment B, corresponding with the outboard part of the wing to the wing tip, ribs 10 to 13.

One of the aileron hinges was attached to fragment A and the other two to fragment B.

The results and main conclusions of the analysis were as follows:

- The structural break-up of the left wing took place at a certain moment during the flight when the stress on the wing exceeded the limits of the aircraft's maneuvering envelope.

This conclusion was reached because

— It was verified that, due to their macro and microfractographic characteristics, all the fractures in each of the wing's fragments, whether total or partial (cracks), were of a ductile nature and were produced in their entirety by static overload, without any fatigue, general or localized corrosion or stress corrosion mechanisms being involved,
— No evidence or signs were found in the wing's structure of previous weakening from phenomena involving fatigue, stress corrosion, general or localized corrosion, or of a static overload preceding the one that caused the disintegration being analyzed, and
— The remains were separated and scattered on the ground.

The analysis of the deformations and fractures on the wing's main spar allowed for the determination of the type and direction of the predominant stresses to which each one was subjected, and to establish the causes and sequence of the wing's structural break-up.

Figure C-7 is a diagram of the reconstruction of the main spar, seen from the wing's leading edge and showing the fractures and deformation suffered. The figure was reconstructed with fragment D of the spar in its original position with respect to the fuselage, that is, at the very instant the wing started to fracture and break apart.

As shown on the diagram, the analysis indicated that the fracture of the spar where it joins the fuselage was produced by a bending moment from the lower to the upper surface. In other words, the separation was in an upward direction and resulted from a set of positive lift loads on the inboard part of the wing (fragment A). On the other hand, the analysis indicated, as shown in the figure, that the fracture in the separated section of fragment B, the outer wing, resulted from a bending moment from top to bottom, indicative of negative lift in that fragment. The analysis showed that said load might have been caused by the aileron, which was deflected upward, as indicated by the analysis of the fractures and deformations near the aileron hinge.

The analysis likewise indicated no signs of flutter on the wing, as evidenced by the lack of «hammering» (repeated blows) on the top of the aileron.

As for the sequence of events involved in the wing's structural break-up, the analysis showed that:

— The transversal fracture of the aileron was typical of those seen in thin-walled cylindrical tubes, such as the aileron, and must have taken place while it was attached to fragments A and B of the wing, since it required the reaction load present in its hinges,
— The fracture between fragments A and B and the separation of the fragments must have taken place while fragment A was still capable of supplying the required reaction, that is, before it detached from the fuselage,
— The fracture of the forward spar took place while it was still transmitting load to the fuselage through its anchor point, in other words, before the spar's anchor point broke off.

Lastly, the analysis concluded that «the stress that produced the fractures in the left wing resulted from a combination of aerodynamic and inertial loads generated by the overall flying conditions, to include atmospheric, maneuvering, configuration (position of control surfaces), and aircraft attitude and weight since no other indications exist which could have caused the abnormal flight stress condition».

1.16.4. *Additional information*

Appendix 10, «In-Flight Break-up», of the *Manual of Aircraft Accidents and Incidents*, ICAO document No. 6920 (4th Edition), dated 1970, in the April 2004 edition, deals with the different kinds of possible in-flight structural failures of aircraft and states that «there are two areas where structures usually fracture or become separated: the wing and the horizontal empennage», and indicates that such fractures depend on the aircraft's aerodynamic characteristics, its structural limits, flight conditions (attitude and speed) and the maneuver being performed, and even on atmospheric conditions (wind, turbulence, etc.).

Supposing a normally loaded aircraft, that is, the wings providing lift (upward load) and the horizontal stabilizers compensating (downward load), then either the wing will break upward (positive overload) or the stabilizers will break downward. In the latter case, the detachment mechanism will depend on the pilot's actions or on the control applied.

Before the stabilizers fracture, the wing is normally subjected to a large positive load, but after the failure, the aircraft will enter into a violent dive angle, the wing will have a negative attack angle and the aircraft's inertia will at first follow the direction of lift. Therefore, the wing, possibly already permanently and upwardly deformed due to the previous positive load, will instantly be loaded in the opposite direction with enough overload to break it downward.

The phenomenon is almost instantaneous, the period of time required being shorter with a higher initial airspeed. The phenomenon can take place so quickly that to an external observer it can look like an onboard explosion. Sometimes the wing's upward deformations remain.

1.17. Organizational and management information

Not applicable to this investigation.

1.18. Additional information

During the investigation into accidents aboard Cessna 210-type aircraft like the accident aircraft, the following cases involving wing fracture and separation were found:

— The one identified by the NTSB as CHI05FA016 involving a P210A aircraft, registration N5485W, on 26-10-2004 and which was probably caused by «the pilot not maintaining airplane control during cruise flight in instrument meteorological conditions after reporting a loss of gyros leading to his exceeding the design load limits of the wings».
— The one identified by the NTSB as NYC04FA144 involving a P210A aircraft, registration N99HW, on 22-06-2004 and which was probably caused by «the pilot's loss of aircraft control and the subsequent overstress and separation of the wing during an encounter with convection induced turbulence». The aircraft lost a wing in flight.
— The one identified by the NTSB as IAD02FA002 involving a 210M aircraft, registration N6053B, on 05-10-2001 and which was probably caused by «the pilot's loss of control in flight due to spatial disorientation, and his subsequent overstress of the airplane during a recovery attempt». The aircraft lost the left wing in flight.
— The accident analyzed in Canada's Transportation Safety Board report Nr. A01O0165 involving a 210L aircraft, registration C-GPMC, on 18-06-2001. The report states that the accident took place after the left wing overloaded and detached from the aircraft, rendering it uncontrollable. A fragment from the wing struck and broke the

vertical stabilizer. The report concludes that a combination of high speed and g forces may have resulted from both pilot action and wind gusts.

None of these reports includes any safety recommendations.

1.19. Useful or effective investigation techniques

Not applicable.

2. ANALYSIS

2.1. Flight preparations

The information available shows that before the flight, the pilot had at his disposal wind and temperature charts for the day in question, as well as the low level significant weather chart.

The most significant meteorological event forecast for the day of the accident was the existence of strong winds from the NNW of increasing intensity with altitude, and which locally could reach speeds of over 60 kt in the accident area. The gusts associated with these winds, also of variable intensity depending on altitude, would produce strong to severe turbulence. At Pamplona Airport, the one nearest to the crash site, surface winds were at 25 kt, gusting up to 35 kt. Horizontal visibility was 10 km and there were scattered clouds at 5,600 ft.

Additionally, the weather conditions on the low level significant weather chart (see Figure A-4) for the accident area called for mountain obscuration, clouds between 3,000 and 9,000 ft, rain, snow and even ice formation, given the altitude of the freezing level (between 2,000 and 3,500 ft).

In spite of this forecast, the pilot did not change the flight level, speed and duration initially specified in the flight plan, requesting a modification to the flight level shortly after takeoff due to the wind.

It is possible that, once airborne, the pilot noticed the intensity of the wind after comparing the speed indicated by the aircraft's anemometer with the groundspeed readout on the GPS.

These facts point to the possibility that the pilot either did not review the meteorological information or interpreted it incorrectly.

An accurate and realistic assessment of the available weather information would have concluded that icing conditions, flying in which was prohibited by the aircraft manual, were possible along the planned route. The aircraft's anti-icing system had a limited capacity and did not allow flying in known icing conditions.

2.2. Accident sequence

Radar data show that the aircraft followed the planned route for the entire flight and that it executed maneuvers as authorized by radio contact, mainly changes in flight level. The course followed, constant and precise as shown in Figure A-5, indicates that the automatic pilot was engaged during the flight. This point, however, could not be confirmed, and could have been of great significance in the course of subsequent maneuvers due to its influence on the aircraft's controllability and handling characteristics, especially if it coincided with severe local icing conditions.

At 09:41:51 the aircraft requested permission to change to FL100 instead of the originally planned «FL180 due to wind». The change was authorized and maintained for the rest of the flight.

The last radio contact was with San Sebastian Airport control and is estimated to have terminated at 13:31:51. During this transmission the aircraft acknowledged the airport weather information it had just received along with the authorization to descend to 5,000 ft.

At that moment, the flight had lasted almost four hours, compared to the 2 hours and 38 minutes called for in the flight plan. This confirms the existence of a strong headwind, even at the lower altitude at which the flight had been conducted. According to the forecast, the wind was also gusting, implying strong turbulence.

The table in Figure B-1 shows ATC radar data from 13:31:21, just before the final radio communication with the aircraft, until the last recorded radar return. In these data, the latitude and longitude coordinates after 13:35:36 are inertial in origin, that is, generated by the radar as the system awaits for a non-existent return signal from the aircraft. Therefore, the last valid radar return for geographic plotting purposes is considered to be the one associated with the previous instant, 13:35:31, point K in Figures B-2 and B-3. In spite of keeping with actual events, the last two returns, showing the start of a turn to the left as seen in Figure B-3, are unreliable.

The flight level and groundspeed data were a constant 73 and 111, respectively, from 13:35:21 on (point J in Figures B-2 and B-3) and are therefore considered to be the last good values for these parameters.

The «Lower airspace radionavigation chart» level significant weather chart (Figure A-5) indicates that radar coverage was guaranteed on airway R10, which the aircraft was following, down to a flight level of 65.

The loss of the radar signal at flight level 73 is therefore considered to be a result of a failure of the aircraft's transponder or, more likely, of the signal being beyond the coverage of ground stations. Given that the antenna is positioned on the aircraft so as to maximize omnidirectional coverage (symmetrically about the aircraft's lower fuselage), the loss of signal would imply that the aircraft had taken on an extreme attitude, either longitudinally or laterally, and possibly that it was out of control. This would also have affected the ability to communicate by radio at that time since the VHF antenna is in a similar location but atop the fuselage. No communications were expected from the pilot in the interval between the last radio transmission and the loss of radar contact.

LEG	DURAT (s)	Change LVL		AVG DESC RATE (fpm)	Groundspeed		Airspeed		CHNG SPD (kt)	CHNG HDNG
		Initial	Final		Initial	Final	Initial Min/max	Final Min/max		
AB	195	100	81	590	105	122	135/170	152/187	+17	Referen.
BC	5	81	81	0	122	107	152/187	137/172	–15	+63°
CD	5	81	81	0	107	105	137/172	135/170	–2	–27°
DE	5	81	80	1,200	105	93	135/170	123/158	–12	–86
EF	5	80	80	0	93	93	123/158	123/158	0	+64°
FG	5	80	79	1,200	93	113	123/158	143/178	+20	–30°
GH	5	79	79	0	113	107	143/178	137/172	–6	+16
HI	5	79	79	0	107	107	137/172	137/172	0	Referen.
IJ	10	79	73	3,600	107	111	137/172	141/176	+4	Referen.
JK	10	73	73	0	111	111	141/176	141/176	0	Referen.

The following table lists the values of flight parameters as recorded by radar for any significant variations which took place for the interval covered by Figures B-2 and B-3. The table shows the initial and final values for groundspeed and flight level recorded for each leg along with the calculated average airspeed (considering the mean value of the wind, 30 kt, indicated as MIN in the table, and with the gusts, 35 kt above the mean value, indicated as MAX in the table), descent rate, the average change in groundspeed and the change in heading for each leg with respect to the previous one. A clockwise change is considered positive.

— The tables and Figures B-2 and B-3 show that:

- The aircraft was descending almost uniformly during leg AB, practically from time 13:31:24, when San Sebastian control authorized 5,000 ft, until 13:34:31, prior to B. During that leg, the flight level went from 100 to 81, equivalent to a descent rate of 590 fpm, which is considered normal.
- Starting with B (13:34:36) and during leg BC, the flight level was maintained (no descent rate) and groundspeed was reduced by 15 kt. A sudden heading change of +63° also took place. No definite cause was found to account for these sudden, abrupt changes, especially in direction. Still, unless the aircraft experienced a malfunction, which is considered extremely unlikely since subsequently it operated normally, it is believed that the change was simply due to a high-intensity gust of wind from the NNW which blew the aircraft off course (Fig. B-3).
- Starting with C, a series of significant positive and negative variations in groundspeed (up to 20 kt in 5 seconds) and heading took place. The variations in the data seem to be consistent with the existence of wind gusts and turbulence

and with control actions on the part of the pilot, since during the variations the aircraft tended to regain the reference course, finally achieving it in leg HI. As confirmed during the investigation, this aircraft model's clean aerodynamic configuration can lead to sudden increases in airspeed with significant attitude changes, requiring extreme caution during corrective actions with the controls so as to avoid structural overloads. The event terminated during leg IJ, with an abnormally high descent rate of 3,600 fpm, which proved to be uncontrollable.
- The data for leg JK is not reliable. This leg maintained the values from time J and the inertial indications after time K (13:35:36).

Although exact values for aerodynamic speed are not available for this sequence, in view of the values included in the table above, it can be concluded with high probability that during the legs between points C and I the aerodynamic speed of the aircraft was clearly above the maximum maneuvering speed (119 kt for an estimated 3,500-lb weight) and even in excess of the maximum cruising speed (167 kt) in some of them. Additionally, it has to be taken into account that during this period of time there were changes of speed, flight level and heading that could have been due to the wind or to the actions of the pilot on the flight controls, and in the latter case they could have been taken to execute a specific maneuver or to counteract the effect of the wind. In any case, these possible actions of the pilot on the flight controls might have been perfomed at speeds in excess of the maneuvering speed and it is possible that they resulted in loads outside the aircraft's operating envelope, which produced a structural failure.

2.3. In-flight structural failure

The inspection of the wreckage revealed that the relevant fractures were ductile in nature, without any signs of fatigue of stress corrosion. To ensure greater reliability, the fractures in the left wing were analyzed in a laboratory, the conclusion being that there had been no previous partial overloads that could have influenced the in-flight fracture that led to this accident.

There were no signs that the repairs that had been made to the aircraft in the year 2002 influenced the various structural fractures. The possibility of flutter was also discarded.

The fractures probably resulted from executing maneuvers at aerodynamic speeds in excess of maneuvering speeds.

It was not possible to determine whether ice formation may have affected the aircraft's controllability, although this is unlikely due to the absence of visible moisture in the area. Also, none of the eyewitnesses who proceeded to the crash site after the accident noted any signs of ice on the wreckage.

3. CONCLUSIONS

3.1. Findings

— The aircraft had a valid airworthiness certificate and had successfully completed all scheduled maintenance inspections within the specified intervals, performed by a duly certified company.
— The pilot had Private Pilot's License (A) with ratings for the type of aircraft and flight in question. He also had a valid Commercial Pilot's License (A) at the time of the accident.
— According to available information, the pilot had 497 flying hours, at least in the period immediately prior to the accident, though at a reduced annual rate. The pilot's experience under critical or emergency flying conditions is unknown.
— The accident occurred during a personal, non-commercial IFR flight. A flight plan had been filed.
— The available weather forecast indicated the existence of intense winds gusting from the north resulting in strong to severe turbulence conditions. Icing conditions due to rain and snow and freezing conditions at low altitudes were also forecast.
— The aircraft's flight manual prohibited flying in known icing conditions.
— The flight's duration was far above that expected probably due to the above-stated headwinds.
— Significant fluctuations in ground speed, flight level and heading were recorded in the last part of the flight probably as a result of wind gusts and strong turbulence and the associated recovery maneuvers.
— An inspection of the wreckage on the ground and eyewitness statements indicated that the aircraft experienced an in-flight structural failure with the separation of key components and that it fell to the ground at high speeds following a turn to the left.
— The outboard part of the left wing fractured and separated in a downward direction, while the inboard part did so in an upward direction.
— Both horizontal stabilizers fractured and separated downward. The right stabilizer fractured at the root while the left one did so toward the tip. The fractures were consistent with overload failure.
— The directions of the fractures and separations indicate that the most likely structural failure scenario involved the downward fracture of the horizontal stabilizers, followed by the downward fracture of the outboard portion of the left wing. The inboard left wing then fractured. This last fracture may have occurred as the inboard portion recoiled following the separation of the outboard segment. The entire process must have taken place very quickly.
— All of the fractures examined were of the ductile type resulting from static overload.
— The fractures on the left wing analyzed in the laboratory showed no signs of a progressive failure as a result of fatigue, localized or general corrosion or stress corrosion.
— There were no signs of flutter.

3.2. Causes

The most likely cause of the accident was the in-flight fracture and detachment of the left wing and the horizontal stabilizer due to static overload in excess of admissible load factors, produced by the combination of turbulence encountered as the aircraft was descending toward the destination airport, and abrupt recovery maneuvers above specified maneuvering airspeeds.

4. SAFETY RECOMMENDATIONS

None.

APPENDICES

APPENDIX A
Location of accident and flight path

Figure A-1. *Map of the crash site*

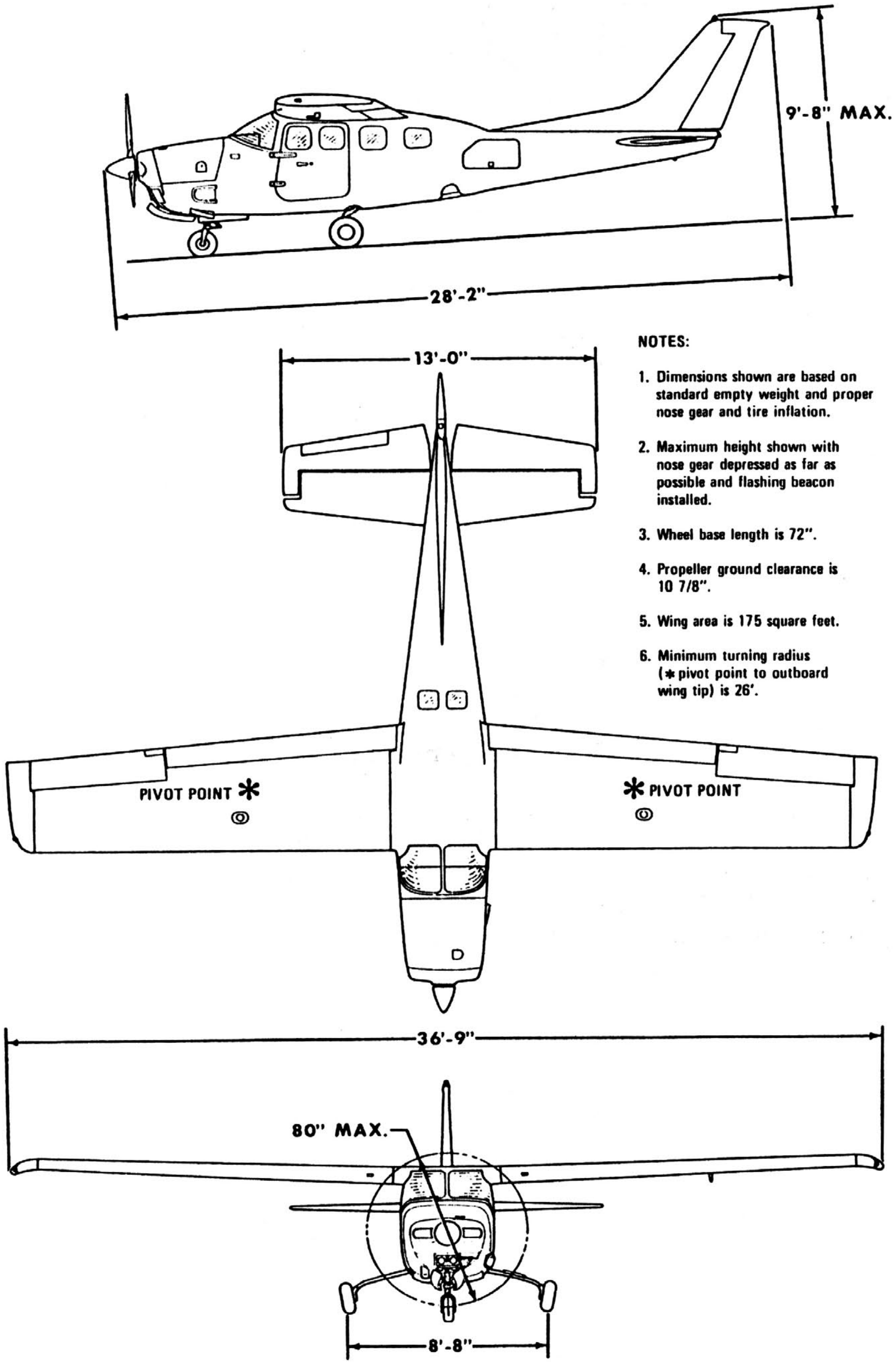

Figure A-2. *Dimensions of a P210N aircraft P210N*

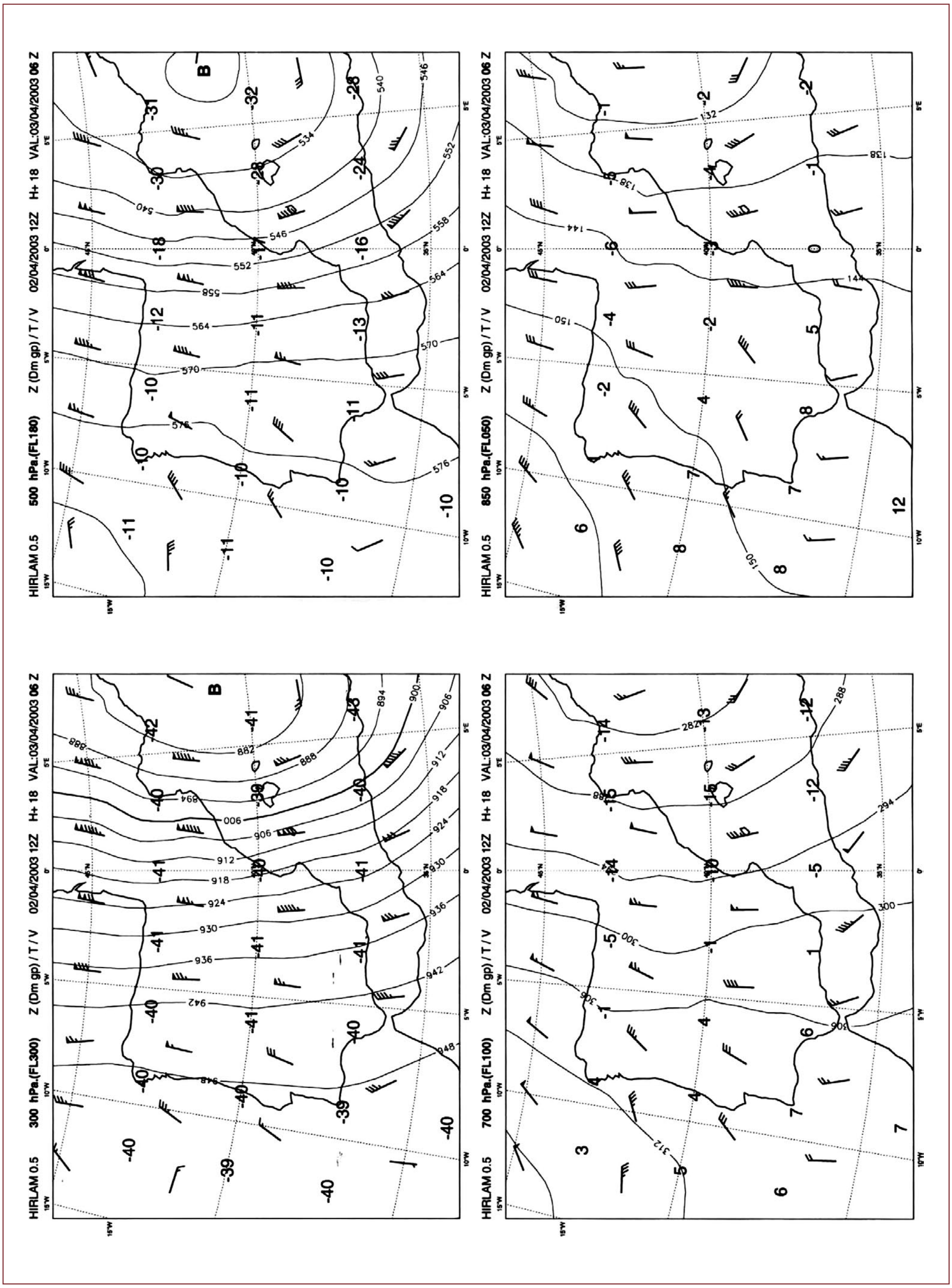

Figure A-3. *Forecast wind and temperature charts for the flight path*

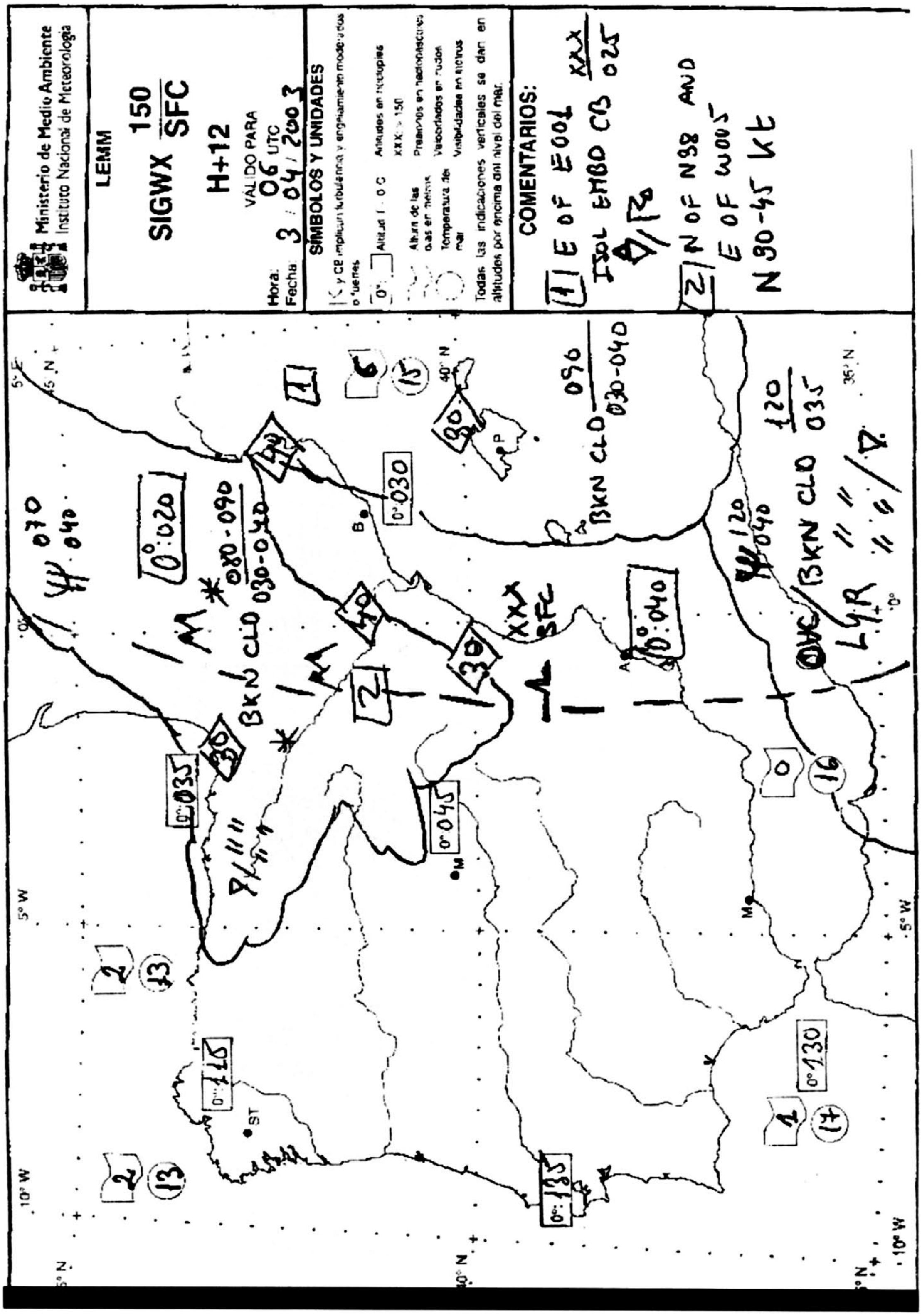

Figure A-4. *Low level significant weather chart*

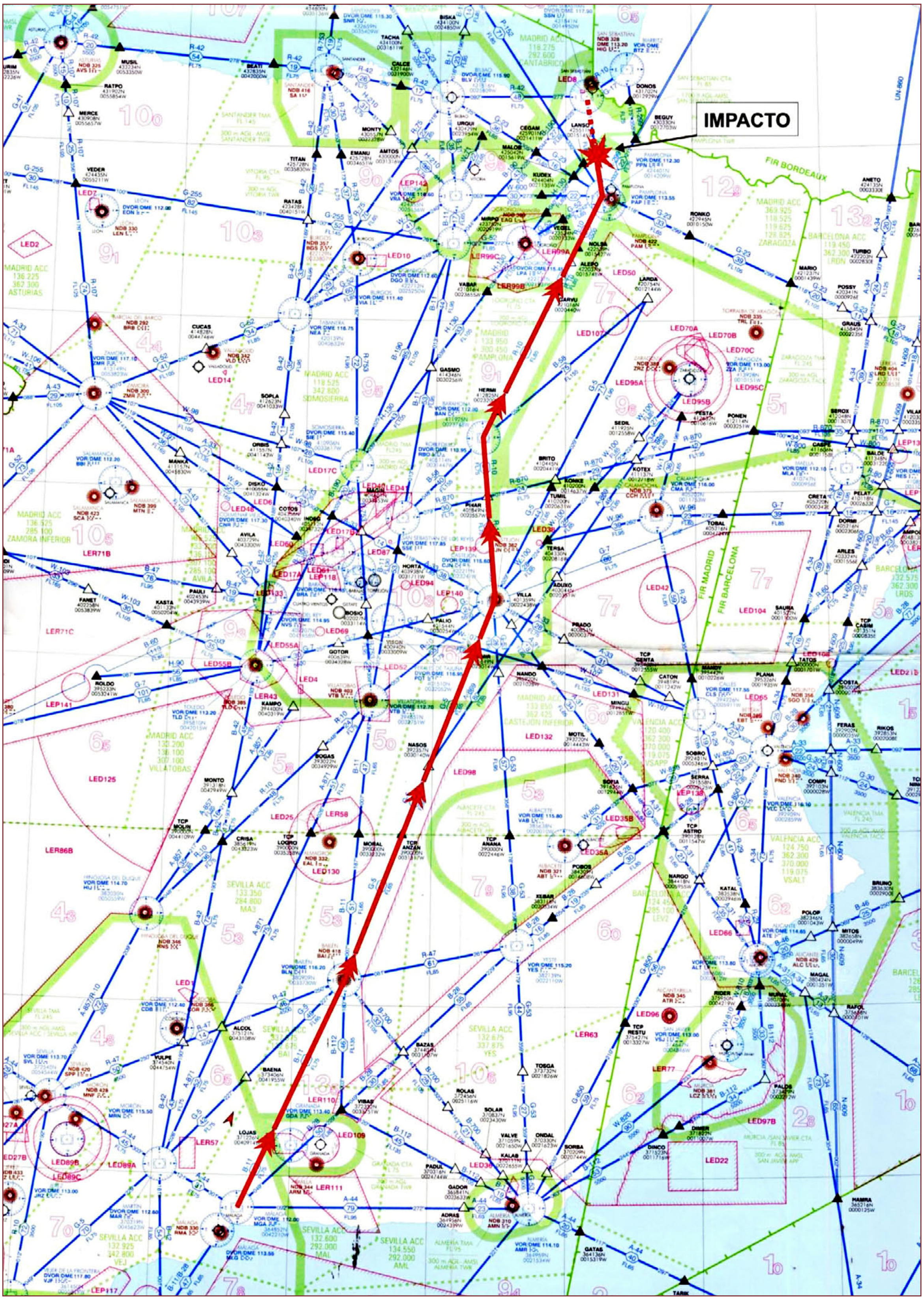

Figure A-5. *Flight path*

APPENDIX B
Flight radar data

Time	Groundspeed (kt)	Flight level (hectofeet)	Latitude North	Longitude West
13:31:21	105	100	42° 53′ 41″	01° 44′ 16″
:26	105	99	42° 53′ 50″	01° 44′ 18″
:31	106	99	42° 53′ 59″	01° 44′ 19″
:36	106	99	42° 54′ 08″	01° 44′ 21″
:41	107	97	42° 54′ 17″	01° 44′ 22″
:46	108	97	42° 54′ 27″	01° 44′ 24″
:51	111	96	42° 54′ 35″	01° 44′ 26″
:56	114	96	42° 54′ 47″	01° 44′ 29″
:32:01	114	96	42° 54′ 56″	01° 44′ 31″
:06	120	95	42° 55′ 08″	01° 44′ 33″
:11	115	95	42° 55′ 16″	01° 44′ 35″
:16	115	95	42° 55′ 26″	01° 44′ 37″
:21	117	94	42° 55′ 36″	01° 44′ 38″
:26	120	94	42° 55′ 47″	01° 44′ 41″
:31	121	93	42° 55′ 57″	01° 44′ 43″
:36	121	93	42° 56′ 08″	01° 44′ 45″
:41	121	93	42° 56′ 18″	01° 44′ 47″
:46	121	92	42° 56′ 28″	01° 44′ 50″
:51	122	91	42° 56′ 38″	01° 44′ 52″
:56	123	91	42° 56′ 49″	01° 44′ 54″
:33:01	123	91	42° 56′ 59″	01° 44′ 57″
:06	123	90	42° 57′ 09″	01° 44′ 59″
:11	123	90	42° 57′ 19″	01° 45′ 01″
:16	122	89	42° 57′ 29″	01° 45′ 03″
:21	123	89	42° 57′ 40″	01° 45′ 05″
:26	122	88	42° 57′ 49″	01° 45′ 08″
:31	124	88	42° 58′ 00″	01° 45′ 10″
:36	124	88	42° 58′ 10″	01° 45′ 13″
:41	123	87	42° 58′ 20″	01° 45′ 15″

Figure B-1. *Radar data*

Time	Groundspeed (kt)	Flight level (hectofeet)	Latitude North	Longitude West
:46	123	86	42° 58′ 30″	01° 45′ 17″
:51	123	86	42° 58′ 40″	01° 45′ 19″
:56	122	86	42° 58′ 50″	01° 45′ 21″
:34:01	122	86	42° 59′ 00″	01° 45′ 23″
:06	122	85	42° 59′ 09″	01° 45′ 25″
:11	122	84	42° 59′ 19″	01° 45′ 27″
:16	122	84	42° 59′ 29″	01° 45′ 29″
:21	122	83	42° 59′ 39″	01° 45′ 32″
:26	122	82	42° 59′ 49″	01° 45′ 35″
:31	122	81	42° 59′ 59″	01° 45′ 37″
:36	122	81	43° 00′ 09″	01° 45′ 39″
:41	107	81	43° 00′ 16″	01° 45′ 36″
:46	105	81	43° 00′ 25″	01° 45′ 35″
:51	93	80	43° 00′ 29″	01° 45′ 41″
:56	93	80	43° 00′ 38″	01° 45′ 42″
:35:01	113	79	43° 00′ 51″	01° 45′ 47″
:06	107	79	43° 00′ 58″	01° 45′ 48″
:11	107	79	43° 01′ 07″	01° 45′ 50″
:16	109	76	43° 01′ 17″	01° 45′ 52″
:21	111	73	43° 01′ 26″	01° 45′ 54″
:26	111	73	43° 01′ 35″	01° 45′ 56″
:31	111	73	43° 01′ 45″	01° 45′ 58″
:36	111	73	43° 01′ 54″	01° 46′ 00″
:41	111	73	43° 02′ 03″	01° 46′ 01″
:46	111			
:51	111			

Figure B-1. *Radar data (cont.)*

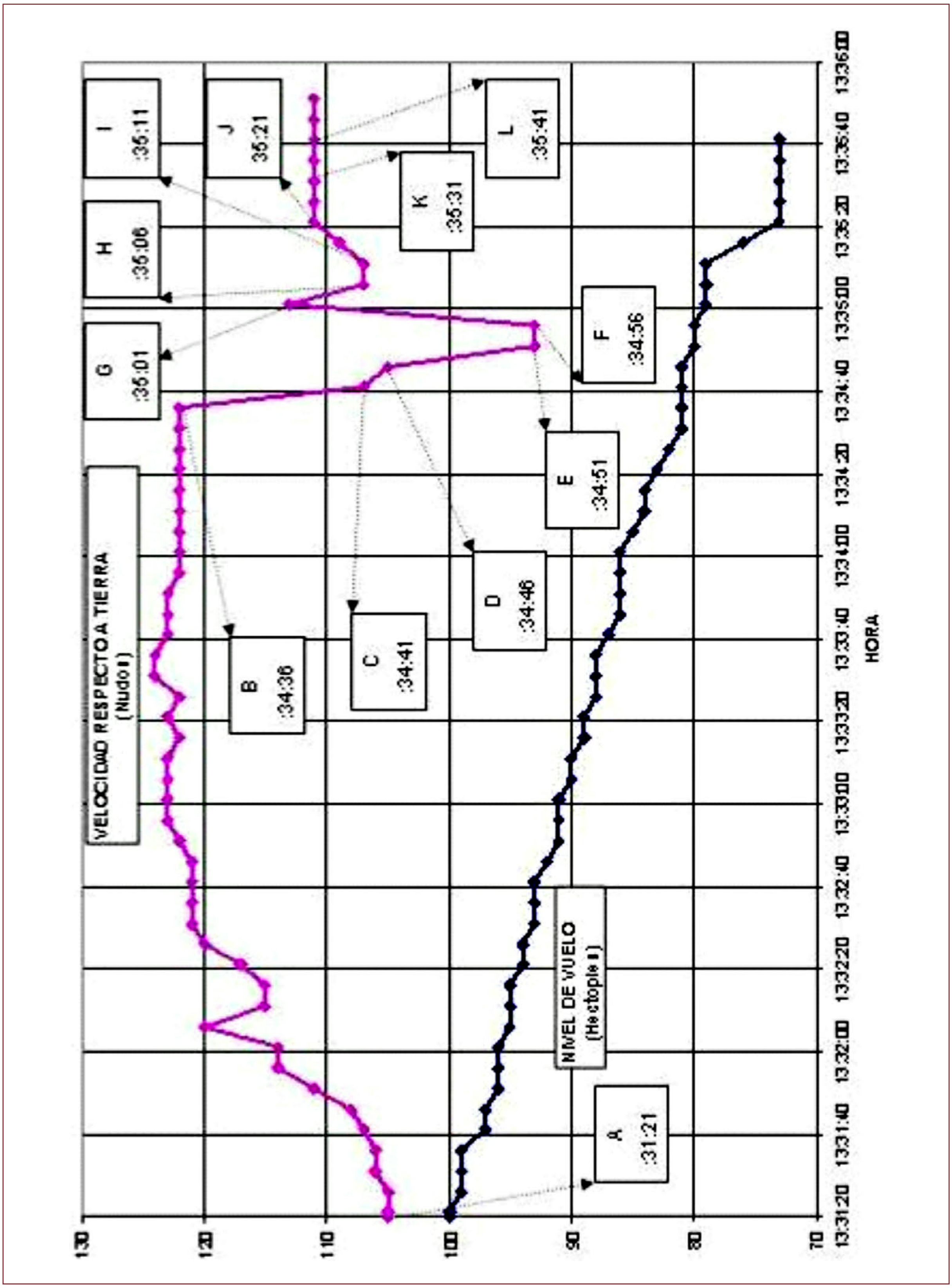

Figure B-2. *Ground speed and flight level*

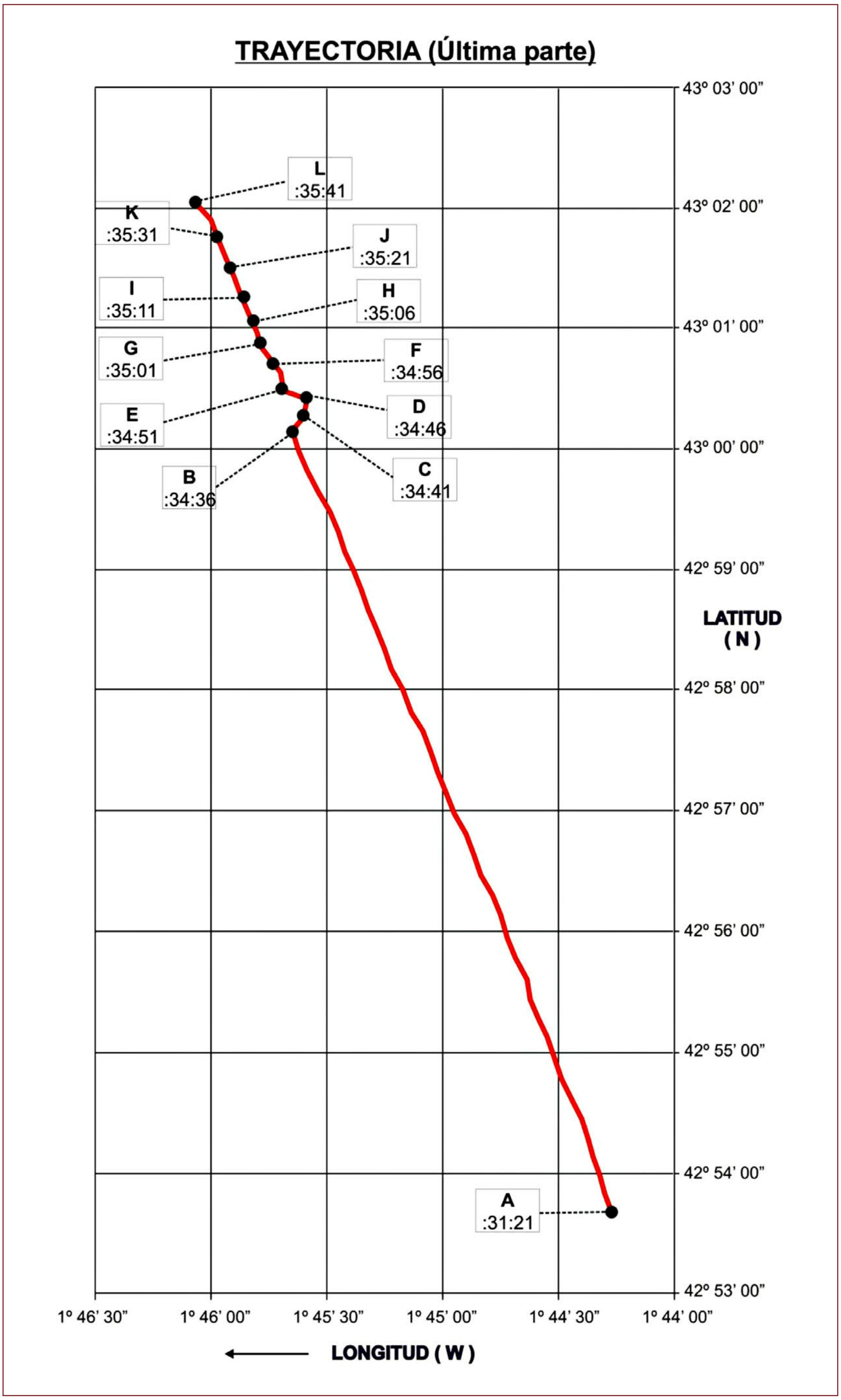

Figure B-3. *Radar path*

APPENDIX C
Layout of the wreckage and photographs

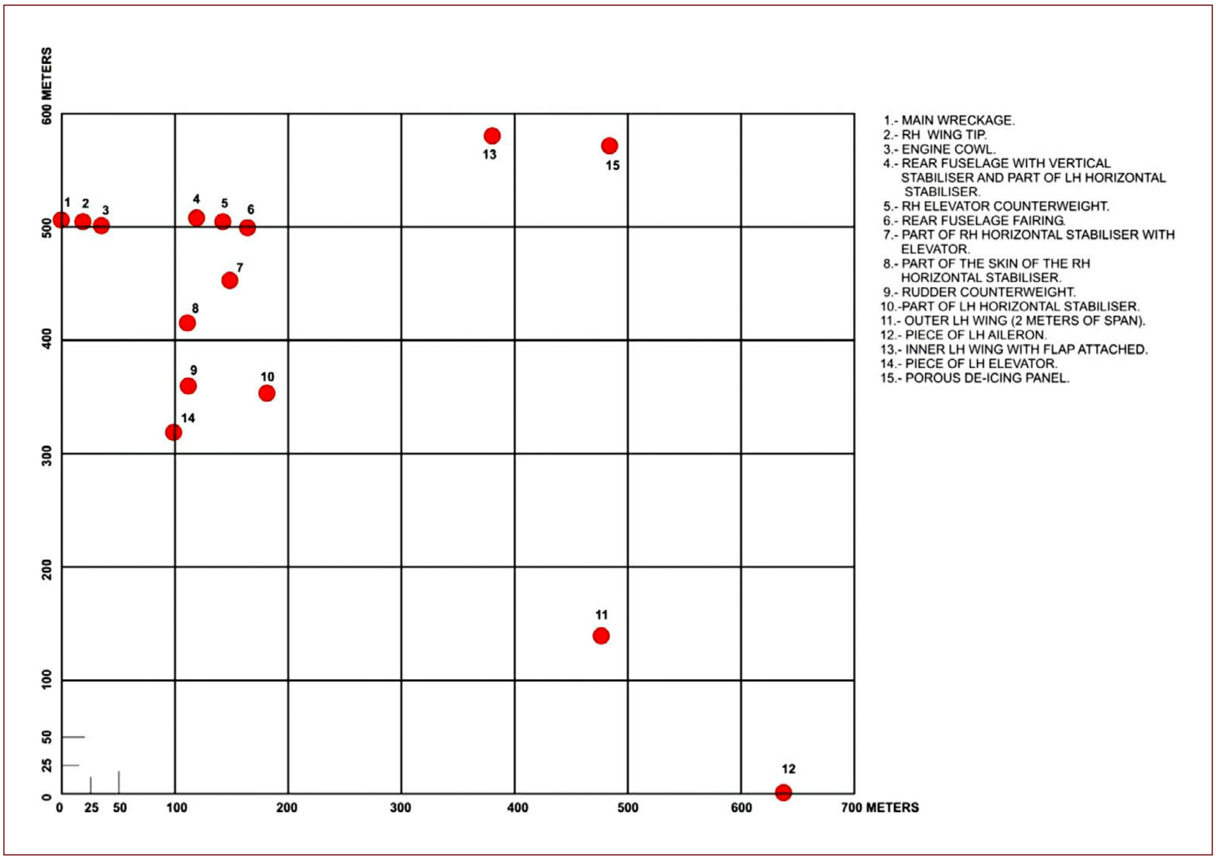

Figure C-1. *Diagram of the relative positions of the remains*

Figure C-2. *Main wreckage*

Figure C-3. *Remains of the propeller (not in original position)*

Figure C-4.1. *Remains of the rear fuselage (view of the tail fin)*

Figure C-4.2. *Remains of the rear fuselage (seen from underneath)*

Figure C-5.1. *Remains of the right stabilizer (inboard part)*

Figure C-5.2. *Remains of the right stabilizer (outboard part)*

Figure C-6. *Remains of the left inboard wing section*

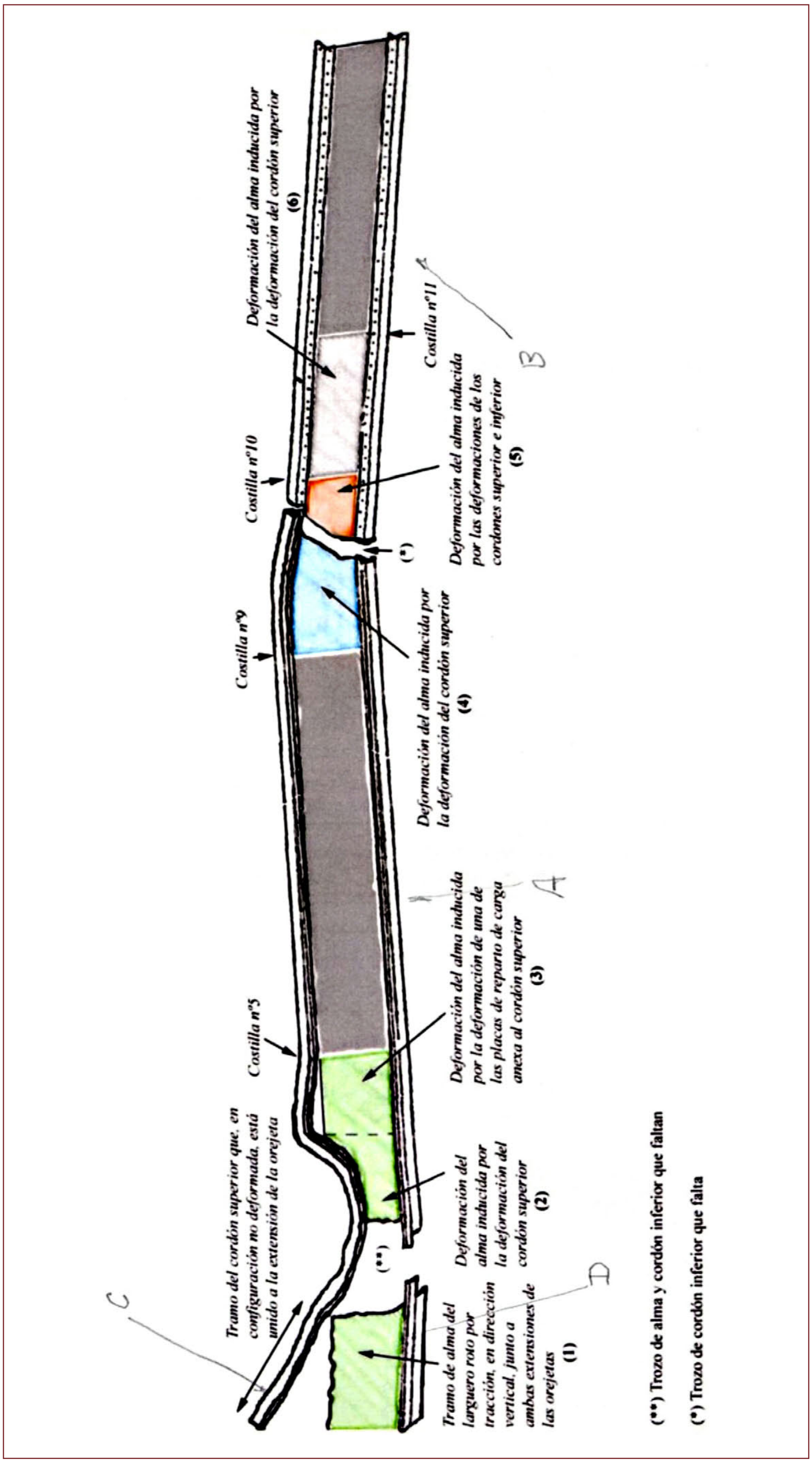

Figure C-7. *Reconstruction of the left wing main spar*