WARNING

This report is a technical document showing the point of view of the Civil Aviation Accident Investigation Comission, relating the circumstances in which the accident subject of the investigation took place, its cause and consecuences.

In accordance to the provisions of Annex 13 to the Convention on International Civil Aviation and Article 12 of the Decree of 28 March, 1974, the investigation has exclusively a technical character and it is not aimed to establish responsibilities nor declaration or limitation of rights. The investigation was conducted without following proof procedures and with no other basic objective than the prevention of future accidents. The results of the investigation do not prejudge nor determine those of a sanctioning proceeding which could be initialled in relation to the accident, and according to the provisions of the Air Navigation Law.

PAGE

Operator:	IBERIA
Aircraft type and model:	Boeing B-727-256
Nationality:	Spanish
Place of accident:	Monte Oiz, 1.027 meters high 30 km. SE of Bilbao Airport 43°13'42" N 2°35'24" W (M. Oiz)
Date and time:	19 February, 1985 08.27:04 hours

NOTE: Times mentioned in this report are all U.T.C., except when otherwise specified.

SYNOPSIS:

Aircraft Boeing B-727-256, registration EC-DDU, of IBERIA Airlines, performing scheduled flight IB-610 (Madrid-Bilbao), crashed into a metallic structure, base of television antennas, placed on Monte Oiz (1027 mts.).

The B-727 took off from Madrid-Barajas Airport at 07.47:00 hours, being scheduled to land at Bilbao Airport (Sondica) at 08.35:00 hours.

The Control Tower at Bilbao Airport had its last contact with the aircraft at 08.22:07 hours, and did not have confirmation of the accident but after about 40 minutes.

Through the analysis of the remains and its dispersion on land it may be asserted that the left wing and the bottom part of the fuselage collided against the antenna, subsequenty suffering other impacts against the ground.

All the passengers (141) and crew members (7) on board the aircraft died as a result of the accident.

Weather conditions at Bilbao Airport at 08.00 hours were the following:

Wind calm
Visibility 4 km. with mist
1/8 cumulus at 3.000 ft.
2/8 stratocumulus at 5.000 ft.
2/8 altocumulus at 10.000 ft.
QNH 1.025
Temperature and dew point $07^{o}/07^{o}$

1.- FACTUAL INFORMATION

1.1 History of the flight

Iberia Airlines aircraft Boeing-727-256, registration EC-DDU "Alhambra de Granada", performing scheduled flight IB-610 (Madrid-Bilbao) took off from Madrid-Barajas Airport at 07.47 hours, being scheduled to land at Bilbao (Sondica) Airport at 08.35 hours.

At 08.09:58 hours Control-Madrid provides estimate and aircraft data to Bilbao TWR:

At 08.16:03 hours first communication between IB-610 and Bilbao TWR was established.

IB-610: "BILBAO TOWER, GOOD MORNING, SIX ONE ZERO."

TWR: "IBERIA SIX ONE ZERO, GOOD MORNING, GO AHEAD."

IB-610: "WE ARE LEAVING ONE THREE, TO LEVEL ONE HUNDRED, TWENTY-EIGHT OUT."

TWR: "ROGER, IBERIA SIX ONE ZERO, STAND BY PLEASE."

At 08.16:33 hours, TWR informs: "IBERIA SIX ONE ZERO, YOU CAN CONTINUE DESCENT, FOR AN ILS APPROACH TO BILBAO, RUNWAY THREE ZERO, WIND IS ONE HUNDRED DEGREES THREE KNOTS, QNH ONE ZERO TWO FIVE AND TRANSITION LEVEL SEVEN ZERO."

At 08.16:44 hours, IB-610 replies: "THANK YOU, DESCENDING TO SECTOR MINIMA, WITH ONE THOUSAND AND TWENTY-FIVE?"

At 08.16:48 hours, TWR replies: "CORRECT, ONE THOUSAND AND TWENTY-FIVE AND IF YOU WISH YOU CAN PROCEED DIRECT TO THE FIX."

At 08.16:55, IB-610 replies: "WE ARE GOING TO MAKE THE ..... STANDARD MANOEUVRE."

At 08.16:57 hours, TWR acknowledges receipt: "ROGER, NOTIFY PASSING OVER THE VOR."

At 08.22:04 hours, the aircraft reports to TWR: "SEVEN THOUSAND FEET, OVER THE VOR IBERIA SIX ONE ZERO STARTING THE MANOEUVRE."

At 08.22:07 hours TWR acknowledges receipt: "ROGER SIX ONE ZERO". This was the last communication with IB-610.

1.2 Injuries to persons

Injuries	Crew	Passengers	Other
Fatal	7	141	-
Serious	-	-	-
Minor/ None	-	-	

1.3 Damage to the aircraft

As a result of the first impact into the antenna, part of the left wheel's tire was lost, as well as the nose gear's left door, left side main gear and the total separation of the left wing. Later and as a result of further impacts with the northeast hill side of Monte Oiz, covered with pine trees, the aircraft was destroyed.

1.4 Other damage

As a result of the impact, the metallic structure of the antenna of "EUSKAL TELEBISTA" into which the aircraft collided, was affected, and a large amount of pine trees were destroyed or damaged. The affected area was of about 20.000 m^2, on the northeast hill side of Monte Oiz.

1.5 Personnel Information

1.5.1. Captain

Sex:	Male
Age:	51 years old
License:	Airline Transport Pilot Number 715
Date of issue:	19-04-1966
Validity:	07-08-1985
Last medical examination:	21-01-1985
B-727 rating:	16-04-1976

Flying experience

Total flying hours:	13.678
Total hours in type as Copilot:	211
Total hours in type as Captain:	4.671
Total hours preceding six months:	29
Total hours preceding ninety days:	29

Total hours preceding thirty days:	17
Rest period prior to flight	72 hours

NOTE: In 1984, from June 19 to July 24 this Airline's Pilots were on strike. As a result of the same, on July 18 the captain's contract was cancelled. On November 1984 he re-entered the Airline. From that date on and until November 29, 1984, he underwent the proper course. Later he passed passed the flight inspections to which he was subject.

1.5.2. Copilot

Sex:	Male
Age:	38 years old
License:	Airline Transport Pilot Number 1.815
Date of issue:	16-01-1980
Validity:	17-04-1985
Last medical examination:	20-03-1984
B-727 rating:	04-05-1981

Flying experience

Total flying hours:	5.548
Total hours in type	2.045
Total hours preceding six months:	283
Total hours preceding ninety days:	143
Total hours preceding thirty days:	52
Rest period prior to flight	24 hours

1.5.3 Flight Technical Officer

Sex:	Male
Age:	38 years old
License:	Flight Engineer number 682
Date of issue:	21-03-1982
Validity:	05-03-1985
Last medical examination:	23-02-1984
B-727 rating:	30-06-1980

Flying experience

Total flying hours:	2.721
Total hours in type:	2.721
Total hours preceding six months:	288
Total hours preceding ninety days:	117
Total hours preceding thirty days:	50
Rest period prior to flight	48 hours

1.5.4 Assistant crew

All assistant crew members held the appropriate licenses and had undergone their training courses.

1.6 Aircraft Information

Type:	B-727-256
Manufacturer:	The Boeing Company
Date of manufacture:	1979
Serial number:	21.777
Registration:	EC-DDU
Owner:	IBERIA, Líneas Aéreas de España
Airworthiness certificate:	num. 1.971
Date of last renewal:	13-05-1984
Validity:	13-05-1985

Maintenance Record

	HOURS	DATE
Aircraft total hours:	13.408	
Total cycles:	12.347	
Total since check A:	115	29-01-85
Total since check B:	471	12-12-84
Total since check C:	928	28-08-84

Engines: Pratt & Whitney JT8D-9A

		Time since overhaul		Total Time
Position	Serial n.	Hours/cycles	Date	Hours
1	665.963	5.094'44/4.475	15-11-82	20.685'44
2	665.795	1.905'37/1.629	04-04-84	23.487'37
3	665.809	775'52/ 663	21-09-84	22.909'00

Weight and centre of gravity

Maximum authorised take off weight	83.552 kg.
Actual take off weight:	66.109 kg.
Centre of gravity at the time of the accident:	25'00% MAC, within limits

1.7 Meteorological Information

METAR at Bilbao Airport were the following:

07.30 hours

Wind.....	110/04
Visibility.....	4.000 meters
Conditions.....	mist
Clouds.....	2/8 cu at 2.500 ft. 4/8 sc at 4.000 ft.
Temperature and dew point...	$07^{o}/07^{o}$
QNH.....	1025

Significant changes are not expected

08.00 hours

Wind.....	110/04
Visibility.....	4.000 meters
Conditions.....	mist
Clouds.....	1/8 cu at 3.000 ft. 2/8 sc at 5.000 ft. 2/8 ac at 10.000 ft.
Temperature and dew point...	$07^{o}/07^{o}$

QNH..... 1025
Significant changes are not expected

08.30 hours

Wind..... 110/04
Visibility..... 4.000 meters
Conditions..... mist
Clouds..... 2/8 cu at 4.000 ft.
4/8 sc at 8.000 ft.
Temperature and dew point... 07°/07°
QNH..... 1026
Significant changes are not expected

On February 17 and 18, a slight surface storm together with a system of associated fronts crossed the Peninsula eastward. It was moving along parallel 40°N, bringing plenty of clouds, mainly over the top half of Spain. On the 19th there were still remains of clouds of the said storm over the Peninsula. There was a low pressure between the Gulf of Cadiz and the north of Marroco which originated clouds over Andalucía. There was a powerful high pressure over Europe of 1.041 mbs., that originated a wind flow from the first quadrant on all levels, towards the Cantabrian Mountain Range, originating stationary clouds over the coast.

Meteosat's photography at 09.00 hours confirms low clouds over the whole of the País Vasco, though not forming a continuous layer.

According to METAR at Bilbao Airport, between 06.00 and 11.00 hours, the sky was cloudy with low fragmented clouds, their bases being at two different heights, 2.500 and 4.000 ft.. Due to existing mist, given the high humidity originated during the night and the proximity to the Cantabrian Sea, the visibility varied from 4 to 5 Km..

Nevertheless, according to Annex 3 of ICAO, METAR data are only representative for the Airport and its vecinity. Taking into account the weather conditions, it is likely that cloudy conditions would be very similar over a greater zone, in all likelihood all along the oriental zone of the Cantabrian coast.

Due to the Euroean high pressure affecting the northern part of the Peninsula, clouds were stratified, reason by which existing cumulus and stratocumulus were 1.500 to 3.000 ft. thick.

Surface wind at the Airport varied from 050° to 110° at a speed of 3 to 5 knots, so reduced visibility remained for several hours due to wind speed. This speed was lower than that corresponding to the existing weather conditions, most likely caused by Bilbao Airport's vecinity orography.

According to witnesses near the site of the accident, this was covered by clouds.

1.8 Aids to navigation

VOR/DME

IDENT.	BLV
EM:	A9W/PON
Transmits:	115.9 MHz
Coordinates:	43°18'15"N 02°56'01"W
Hours of operation:	24

Location:	0.30NM on a magnetic heading of 294° from the Airport's reference point.
Power:	0.2Kw
DME	Channel 106X

NDB

IDENT.	BLO
EM:	NON/A2A
Transmits:	370 KHz
Coordinates:	43°19'26"N 02°58'26"W
Hours of operation:	24
Location:	2.43NM on a magnetic heading of 309° from the Airport's reference point.
Power:	0.25Kw
Coverage:	70 NM

NDB

IDENT.	BIL
EM:	NON/A2A
Transmits:	323 KHZ
Coordinates:	43°11'17"N 02°35'47"W
Hours of operation:	24
Location:	27.070 m. from threshold of runway 30 and 150 mts. to the right side of the runway centreline, in ILS approach sense.
Coverage:	50 NM

L

IDENT.	B
EM:	NON/A2A
Transmits:	395 KHz
Coordinates:	43°22'26"N 03°02'01"W
Hours of operation:	Airport schedule
Location:	7.04NM on a magnetic heading of 320° from the Airport's reference point.
Power:	0.02Kw
Coverage:	15 NM

1.9 Communications

The Tower at Bilbao Airport includes ground-air communications equipment, whose characteristics are as follows:

Approach - APP

Service	APP
Call sign	Bilbao APCH
EM	A3E
Transmits and receives on:	120.7 MHz
Time of operation:	OCT/MAR 06.30/21.00

Tower - TWR

Service	TWR
Call sign	Bilbao
EM	A3E

Transmits and receives on:	118.5 MHz 121.7 MHz (Ground control) 121.5 MHz (Emergency)
Time of operation:	OCT/MAR 06.30/21.00

Each and everyone of these instruments transmit and receive in the same frequency and include recorders, so all communications were registered.

1.10 Information on the aerodrome

Does not affect.

1.11 Flight recorders

The aircraft had a CVR (Cockpit Voice Recorder), and FDR (Flight Data Recorder) which were recovered on the same day of the accident, both being installed at the tail cone, behind the pressure bulkhead.

1.11.1 CVR

This is a Sundstrand recorder, model AV-557C, S/N 9060, P/N 980-6005-074 and Date Code 1,078.

When it was removed it could be seen that the tape was in good condition for its hearing, although its protection suffered light damage.

1.11.2 FDR

This is a Sundstrand recorder, model FA-542, S/N 2724 and P/N-101035-1.

When it was removed it could be seen that it was in good condition for its analysis.

This equipment registers the following parameters:

- Time
- Heading
- Microphone pulsation
- Speed
- Altitude
- Vertical acceleration

1.12 Wreckage and impact damage.

The first impact was located at 43° 13′ 43" N-02° 35′ 26" W, at about 30 km. SE of Bilbao Airport. It took place against the base structure of antennas 54 mts. high, which base was close to the top of Monte Oiz, at a height of 1.000 mts.

This first impact occurs aproximately 10 second after the beginning of the turn towards the final approach to runway 30 at Bilbao Airport. At this moment the airplane was under control, with a warping of 29°, descent rate of 600 ft/minute, and an IAS of 208 knots. The engines were at low power and the automatic control of the flight controls was connected.

The collision into the platform existing at 42 mts. from the base support of the antennas, starts with the bottom left part of the nose, before the front gear's accomodation. It continues to graze the bottom left part of the fuselage, and when the left wing collides it breaks loose.

The left wheel and door of the nose gear, as well as other elements of the door's mechanism are removed by the impact againts the said platform, at a logical distance close to the base. Some of the airplane's elements from the nose to the wing's mesh, air conditioned system, and part of the thermic isolation are detatched on impact. There also apear pertinently distributed (the lesser the relation weight/surface is the closer they are to the point of impact) the main gear and the support beam of the said gear. In addition, the detatched wing turns and crashes into some rocks close to the mountains top. It moves along the terrain's hill side, show the trayectory of the airplane, remaining at 620 metres from the base.

After losing the left wing and with no possiblity of control, the airplane follows the course it had at the time of the impact. It follows a parabolic trayectory in the vertical plane and turns counter clockwise, with respect to its longitudinal axis, colliding face down into the mount's hill side, at 930 metres from the base of the antennas. It continues to advance razing the forest, openning a path in which are left remains of the tail and top-front fuselage, as well as part of engine n. 1. The main remains (nose gear with the right wheel, right main gear, and engines 2 and 3 complete, as well as the rear part of the fuselage, including the stairs whose zone was easily recognizable in its shape), remain on the lowest part of a valley at the end of the hill side.

1.13 Medical and Pathological Information

Due to the nature of the impacts suffered by the aircraft against the ground, after colliding into the antenna, there were no survivors to the accident.

The whole of the victims showed mutilations and/or polytraumatisms, which were the cause of death. There is no evidence of death due to asphyxia nor as a result of fire.

1.14 Fire

There was not a general fire of the aircraft as a result of the impacts, but only small isolated fires, caused by the fuel spilled from the broken tanks and in contact with metallic remains, heated by the energy generated in the impact. The tail cone and the engines were the most affected parts.

1.15 Rescue and survival

About 40 minutes after the last communication between the aircraft and Bilbao TWR took place, notifying of its pass over the VOR, a telephone call confirmed the accident. Local medical and firefighting services left for the site of the accident immediately. At the same time the public order forces surrounded the zone in order to protect the remains and rescue works. Rescue of the remains of the aircraft's occupants was complex, it was coordinated in two stages, first up to the hill side of the mountain and from there in helicopters to certain

facilities set up to that effect in the city of Bilbao, for identification purposes. The accident left no possibility for survival.

1.16 Test and research

1.16.1 AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS)

The aircraft included Sperry equipment, model SP-150 MBV.

The "Automatic Pilot" (A/P) provides flight control of the three axis of the aircraft and allows category I and II approaches.

Its controls were located on the rear electronic panel of the centre pedestal, accessible to both pilots. It includes the following elements (Fig. 1):

- "PITCH SELECTOR" control, allows selection of the following modes:

  VERTICAL SPEED position at which it returns by spring as long as any other mode has been deactivated.
  PITCH HOLD (attack angle hold)
  PDC SPEED (Speed programmed by PDC or by the pilot)
  IAS HOLD and MACH HOLD (These positions are not activated in the system).

- "VERTICAL SPEED" control, allows the pilot to send to the A/P an specific climb/descent regime or to maintain its altitude. If this control is used the Pitch Selector jumps to Vertical Speed position, no matter what mode had been selected.

- "TURN" control, controls the aircraft warping. It can be maintained in any position, having a retention in the neutral position, required to connect the A/P.

- "HEADING SELECTOR" switch, allows the A/P to drive the aircraft to the selected heading.

- "ENGAGED-DISENGAGED" switch, simultaneously engages the pitching-warping axis, it is activated through solenoid when the appropriate electric circuits are closed, switching to unclutched position when any of the said circuits is opened. If the opening of any of these circuits s not commanded by the switch located on the control column of any of the pilots, the "AUTOPILOT DISENGAGED" warning lights (flashing red), located on the front panel of both pilots, are light.

- "NAV. SELECTOR" switch, selects the modes:

  AUX. NAV. (this position is deactivated by the system)
  NAV. LOC.
  TURN. KNOB.
  AUTO G/S.
  MAN G/S.

- "ALT. SEL" switch, is used together with the altitude selector in order to capture the pre-set altitude. This switch is of the "press to connect-press to disconnect" type. Two lights exist in this switch: ARM (amber) and ENG (green).

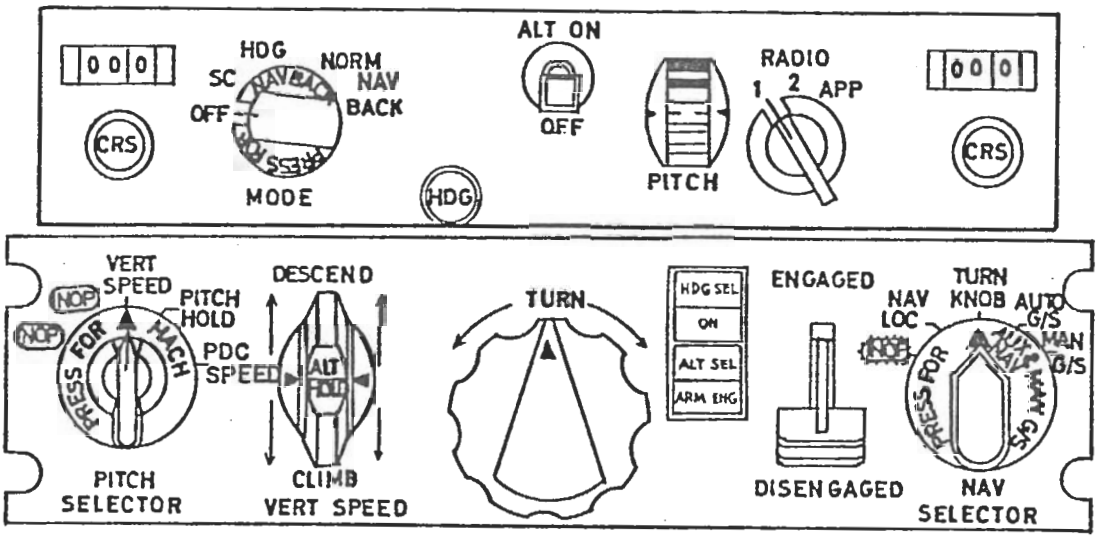


Fig. 1

1.16.2 ALTITUDE WARNING SYSTEM

The aircraft included a Sperry equipment, P/N 25933564-908, S/N 2020312 and its modification status A,B,D,E,F,G,J,S, as notified in its identification plate.

This system provides visual and acoustic warning signals whenever the aircraft deviates or gets close to a selected altitude. This altitude must be previously set manually by any of the pilots.

The altitude warning system includes the following elements (Fig. 2):

- ALTITUDE SELECTOR, placed in the front electronic panel, accessible to both pilots and formed by:

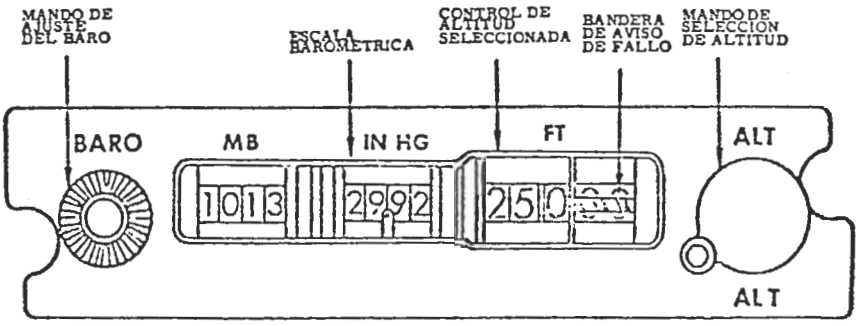
  - A "BARO" adjustable knob with double window to make visible the barometric scale both in milibars and inches of mercury.

An altitude selection knob, with which the pilot may preselect the required altitude in 100 feet increments up to a maximum of 49.000 ft.. Whatever is selected appears on a window in which, in case of equipment failure, a warning flag appears (black and white stripes). A red flag appears (negative altitude indicator) in case an altitude below sea level has been selected The altitude selection control button, when pressed acts as a RESET button which switches the approach/deviation mode to approach mode. One complete turn of the knob equals a variation of about 3.000 ft. in the altitude indicator dial.

- ACOUSTIC WARNING UNIT, located on the roof panel. The acoustic signal is a 1 to 2 seconds musical tone.

- TWO LIGHT SIGNALS, located one in each control panel, with an "ALTITUDE ALERT" identification written on them.

- SYSTEM INHIBITION DUE TO FLAP POSITION SWITCH, placed in the right gear's accommodation. It is turned on when flap position is over 25^{o}.



CONTROLADOR DE ALERTA DE ALTITUD

Fig. 2

The Altitude Alert system operates according to the following sequence:

When the aircraft is heading to the selected altitude and is 900 feet from it the audio generator is activated and a steady amber light signal is light. While still getting closer to the selected altitude and when it is 300 feet away, the light signals are turned off and the system automatically switches to deviation mode. When the difference between the airplane's altitude and the selected altitude is less than 300 feet there is no warning signal. In case of a deviation of over 300 feet from the selected altitude, the audio generator is activated and the flashing lights are turned on; these flashes are maintained until it moves 900 feet away from the selected altitude. From this point on the system is automatically rearmed to approach mode.

In general, the Altitude Warning System is used together with the A/P. In this case, the operating sequence is as follows (Fig. 3): once the pilot has selected the desired altitude and has set

the barometric pressure with the "BARO" button, the set is armed by pressing the "ALT. SEL." button placed in the A/P control panel, and the ARM light (amber) placed on the same button is turned on. When the aircraft is 900 feet away with respect to the selected altitude, audio generator is activated, the "ALTITUDE ALERT" amber steady lights, placed in the panels of both pilots are turned on; these lights are turned off when the aircraft is 300 feet away from the selected altitude and is approaching the same; depending on the descent rate and on the altitude error at a pre-set distance from that which was selected, the ARM light (amber) shall go off and the ENG light (green) shall glow, indicating that the aircraft has changed to ENGAGED mode beginning to level towards the selected altitude until it is captured, changing then to capture mode. This light shall remain on until the aircraft leaves the captured altitude.

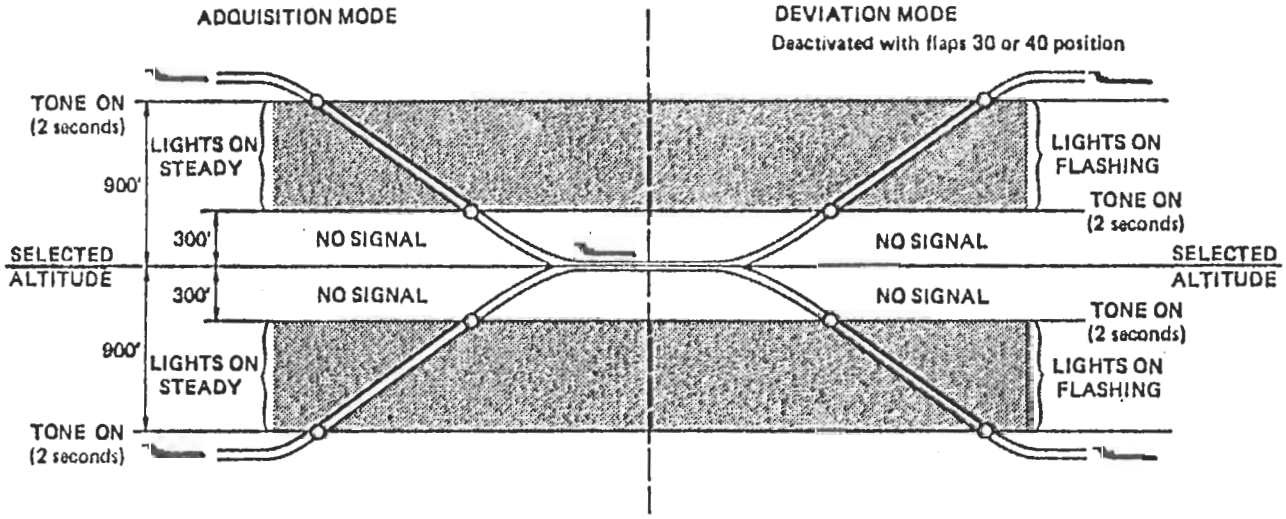


Fig. 3

1.16.2.1 TESTS

Tests have been carried out on performance of the Altitude Alert System:

A).- Laboratory tests
B).- Flight tests

A).- Laboratory tests

1.- The Altitude Alert equipment was recovered from the aircraft remains; it was quite damaged by the impacts. On the altitude selection window, the ten thousand drum showed no digits (indicating a selection of under 10.000 feet), the thousand drum showed number 4 and the hundred drum showed number 3.

The barometric pressure selection window only showed that corresponding to inches of mercury (showing 30.27, which corresponds to 1025 Mb.). The Mb. window had disappeared.

It was found that the ten thousand and thousand drums were blocked, they did not turn around its axis. It could be seen that the upper lid, as a result of the impacts, had been separated and was bent outward, and on its internal face it could be seen the print left by a cogged wheel belonging to the altitude

selector's mechanical transmission system, thus it can be asserted that there was a first impact which blocked the axis of the wheels which drag these drums.

The hundreds drum enabled a slight movement from digit three to digit two (this movement did not drag the mechanical transmission). The pressure indicator window digit drums, in inches of mercury, could be moved.

In view of the above, it was considered the possibility of it being studied in the laboratory in order to see if the positions of the system's mechanical elements or its electronic components would allow the determination of the last altitude selection.

Once it was analysed it was found that no other conclusions could be reached other than the aforementioned, mainly because among the electronic components the fine syncro which was lost in the accident was missing, the thick syncro appeared off its blocking position with its turning axis spinning freely, and the mechanical component does not have an initial reference position.

2.- In order to make an analysis of the system's performance, a system similar to that recovered in the accident was used (Sperry, P/N 2593564-908, S/N 3120447 with a similar modification status). Two

type of tests were performed: operating study as an independent system and as a system connected to the A/P.

2.1 As an independent equipment it was found that the operating sequence matched, both the acoustic and visual signals, with the description of paragraph 1.16.2. Variations of +/-50 feet were founds in the performance of the signals with respect to what is established.

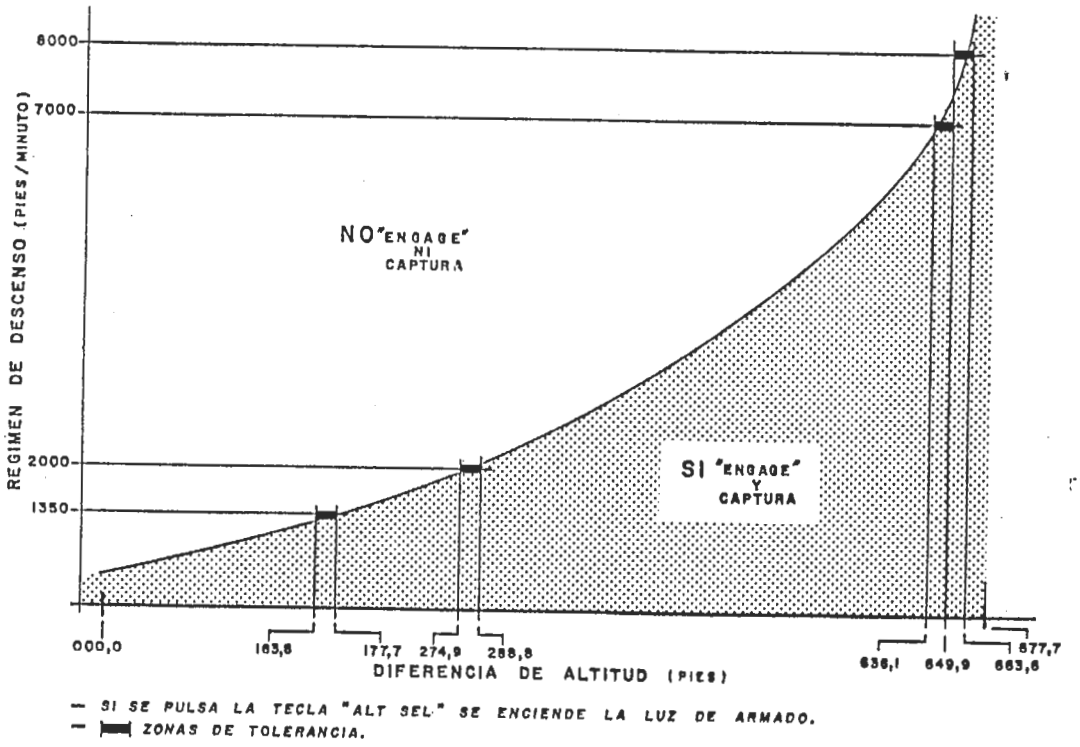
Maintaining an altitude, any variation is interpreted as a withdrawal from the previously selected altitude, and hence by moving the dial to a new altitude we will get flashing visual and acoustic warnings.

When the system is in deviation mode, if the "RESET" button is pressed it switches to approach mode and a momentary acoustic signal may appear.

2.2 As a system connected to the A/P and once the whole set is subject to its logical operating sequence, that is: establishing a barometric reference, setting the desired altitude on the altitude selector, performing RESET, selecting pitching mode and locking the system, we can point out the following results:

- Once the system has been locked, when selecting pitching mode (with VERT SPEED). The approach rate to the selected altitude must be performed according to the aircraft's position with respect to the said altitude. If the aircraft is over the selected altitude the descent rate knob should be turned to DESCEND position. If the aircraft is below the selected altitude and the knob is turned to DESCEND position the system does not perform ENGAGE phase and the airplane would always be descending (the ARM light would remain light).

- ENGAGE phase begins at a varying point depending on the descent rate and on the calculation of altitude differences performed by the system.



- When ENGAGE phase begins the ENG light (green) is turned on and the ARM light (amber) is turned off, the PITCH SELECTOR control moves to VERT SPEED position, the aircraft begins a smooth approach manoeuvre towards the selected altitude. This manoeuvre ends at the locked-on point.

- When the altitude selection equipment detects that it is between 40 and 10 feet with respect to the selected altitude, locked-on mode is activated and the A/P switches to ALT HOLD mode; ALT SEL mode is deactivated.

- If the VERT SPEED knob is moved once the ENGAGE point is reached, ALT SEL mode is deactivated, which causes the airplane to continue on the manually selected rate.

- When pressing "ALT SEL" below a point called of "indecision" which is close to the ENGAGE point (about 25 to 50 feet below the former) the ARM lockec light will glow, but ENGAGE phase will not be performed, and the amber ARM light will remain on. The airplane will continue on its descent rate failing to capture the selected altitude and the deviation acoustic and visual signals would become active.

B).- Flight tests

Tests with airplanes of the same type were performed and they were subject to different descent rates, obtaining the following results:

- The visual and acoustic signals sequence matches the above mentioned description of the system, although the ENGAGE point (subject to the descent rate and to the calculation of the altitude difference), varies from that observed in the system's performance at the laboratory due to the use of the aircraft's altimeter as a reference.

- In order to perform the lock-on operation the A/P's "ALT SEL" switch must be turned on before reaching the ENGAGED point (with a 25 feet tolerance); in case of it being connected later the aircraft does not capture and continues its descent.

- If it is armed below the selected altitude the aircraft does not recover the selected altitude but continues its descent.

- Once it has been armed, if within the ENGAGED phase the "VERT SPEED" knob is moved manually the capture status is lost and the aircraft continues descending on the manually selected rate.

- If for any reason, once it is armed, the A/P is unclutched, the selected altitude alert system is maintained but not armed. It does not recover armed status even if the A/P is clutched again.

- Under descent rates close to 2.000 ft/minute, starting at a reference altitude, a new altitude being selected and the system being armed before leaving the said altitude; depending on the difference between the reference altitude and the selected altitude, it is observed:

  In case of differences of over 900 feet, when adjusting the altitude to capture, the 300 feet withdrawal acoustic signal was the first to be turned on and the "ALTITUDE ALERT" lights remained off (since, in the dial, the withdrawal from 300 to 900 feet is fast, and does not allow the light operating sequence to be noticed). When passing, in the dial, 900 feet (withdrawal) the system remained in approach mode and once it had been armed and the descent had begun, the aircraft captured the selected altitude, according to its normal sequence.

  In case of differences equal or over 900 feet and over its point of "indecision", when adjusting on the ALTITUDE SELECTOR the new altitude to capture, the 300 feet withdrawal acoustic signal was the first to be turned on and the ALTITUDE ALERT" lights remained on flashing. Once it was armed and the descent had begun, the selected altitude was captured according to the normal sequence. When repeating the operation for the same difference, once the new altitude had been selected

and armed, the selector's button was pressed and an acoustic warning heard and the system switched to approach mode thus the "ALTITUDE ALERT" light signals remained on with a steady light, the rest of the operation was performed according to its normal sequence. In case of differences equal or over 300 feet the system does not capture, since the point of indecision" had been surpassed.

The same sequences were achieved in case of rates higher or lower than the above, taking into account the existing variation between their points of "indecision".

1.16.3 DRUM AND NEEDLE ALTIMETERS READ ERRORS

After consulting bibliography on the subject, the following documents were chosen:

NASA TM - 81967 "How a Pilot Looks at Altitude".
NASA CR - 3306 "Instrument Scanning and Controlling: Using Eye Movement Data to Understand Pilot Behavior and Strategies".
NASA TP - 1250 "Airline Pilot Scan Patterns During Simulated ILS Approaches".
NASA CR - 1535 "The Measurement and Analysis of Pilot Scanning and Control Behavior During Simulated Instruments Approaches".

"HUMAN FACTORS IN ENGINEERING AND DESIGN", McCormick, Ernest J.
"HUMAN FACTORS DESIGN HANDBOOK", Woodson.

Several paragraphs have been excerpted which may be applied to the analysis of this accident: basically the first two documents have been used.

In hypothesis a "good instrument" is that which is easy to read and offers to the pilot the information that he seeks and needs. The anemometer is a good instrument. It requires just one look for it to be read and provides the necessary amount of information. Probably the drum and needle altimeter is not a "good instrument" since it requires to look at it twice, once to read the needle and another look to read the drum. There are times in which both can be read at the same time and there are times in which the pilot will only be able to see one of them.

The amount of time needed to read the instrument can be measured as the time in which the eyes are within the limits of the instrument. In practice this is not possible since the information's relative importance is not taken into consideration. In terms of human information processing, the instrument's quality may be a factor to consider when determining the time taken by the perceptive/cognitive process as part of the cognitive work load.

The work load and the flight type, whether manual or automatic, are most important. When using the automatic pilot the monitor patterns are faster (shorter fixation duration). But in human performance increased speed generally has a trade of to accuracy. This includes two possibilities: the picture of the aircraft's position is less accurate in the automatic mode and/or detection of a significant deviation will be less likely under automatic than under manual operation.

A second consideration is psychological uncertainty. The pilot's actions are predicated on what he knows or thinks he knows about the aircraft's position. The uncertainty about a parameter will grow from the time of last examination and will be weighted relative to the importance attached to the

parameter. Knowledge about a starting altitude and a constant rate of descent would yield a slow growth of uncertainty. Because of instrument redundancy, the growth of uncertainty will not necessarily be dependent on the time which has elapsed since his last look at a particular instrument.

The eye movement suggests the altimeter is an instrument of low priority despite the fact that trainers and pilots claim it to be high.

This statement is not consistent with his looking behaviour if we include the secondary information available from other instruments. Altitude information may have a high priority but uncertainty will grow rather slowly keeping the altitude information in a lower priority position than some other parameters.

The level of uncertainty for a parameter will be a function of the pilot's memory (from a previous look), his integration of that information into the overall picture which will depend on more recent information from other correlated instruments, and his prediction based on the integration.

The arguments presented here imply that the pilot could know what the altitude was fairly accurately without having looked at it in a while. Measuring the accuracy of a verbal response in relation to time since the pilot looked at the instrument should give a reasonable indication of his uncertainty.

Tests from which the results were obtained were performed on a FAA certified simulator; the only change in the instrument panel was the incorporation of an oculometer optical head, which was mounted below the Automatic Direction Finder (ADF) behind the instrument panel. A TV camera was mounted

behind the pilot to view the instrument panel and a TV monitor was located behind the pilot's seat to allow the test conductor to observe the pilot's lookpoints superimposed on the instrument panel scene.

On ILS approach the pilots spent around 3 to 6% of the total time looking at the altimeter. Even so they still receive altitude information from the glide slope and the F.D. bars.

The results of these tests show that pilots look very little at the thousands of feet window (apparently because it is difficult to read) as indicated by the average fixing time of 0.6 seconds.

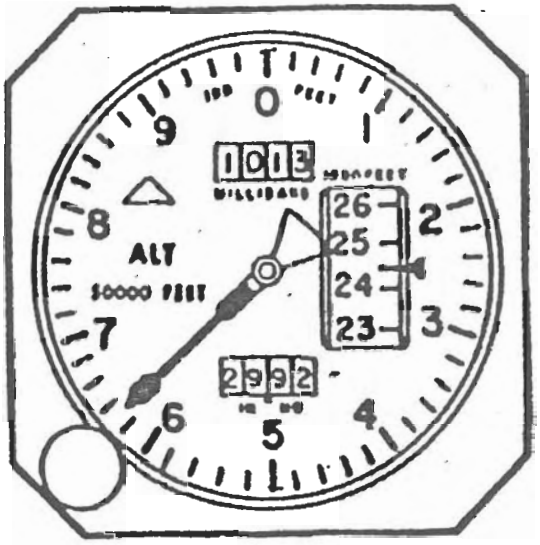
The normal altimeter design is not quite adequate, as indicated by the number of accidents/incidents as a result of misreadings.

A survey was carried out in order to ascertain the percentage of pilots who have misread or observed another pilot misread the drum altimeter. The results of the survey indicated that of the 169 pilots who responded, 137 stated that they had misread the altimeter and 134 stated that they had observed another pilot misread the altimeter (85% of each group stated that such observations had been made on more than one occasion). The results of the survey also indicate that a surprisingly large number of misreads (50) happen during the approach phase.

Several comments of pilots relating the drum altimeter are:

1/ "This altimeter takes more concentration than should be necessary to read accurately."
2/ "The window is a complication on the instrument and is quite small, often requiring a 'double look' and diverting attention from the needle. Other instruments require only a

single point of visual attention to comprehend and do not divert, slow or complicate an instrument check."



3/ "Misreads seemed to always occur at the lower altitude when attention is split between more activities."
4/ "The more stressed situations produced more misreads."
5/ "A quick look after (being inattentive) can usually induce a reading of 100 feet off if the barrel drum is halfway between thousands."

Pilots normally rate the altimeter as the third most looked at instrument in the aircraft (with the F.D. being first and the anemometer second). In fact, when asked, some pilots stated they spent 20 to 25% of their time on the altimeter. Studies conducted using the same pilots (ref. NASA TP-1250) indicate that for all test conditions they actually spent an average of 3 to 6% of their time looking at the altimeters. The discrepancy between pilot opinion and the actual time spent on the altimeter may not be as bad as it seems at first glance.

Indications are that while the pilot may in fact be concerned about his altitude 25% of the time, it does not equate to spending that much time looking at the altimeter. On the straight and level portion of the approach, once having established its altitude, the pilot can use either the horizontal command bar of the F.D. to indicate position with respect to desired altitude or other cues which indicate that change in altitude is taking place. Upon starting the descent, additional instruments also provided altitude information.

To quote a NASA test pilot: "On the glideslope the altimeter is all but relegated. My sources of information are first the glideslope, second, F.D. bars, and third, where present, co-pilot call outs.". While the first two do not give absolute altitude information they do tell the pilot where he is with respect to his desired altitude at that point in his approach. Therefore, while a pilot may in fact spend up to 25% of his time concerned with altitude information, it is not necessary, however, that he spends all of that time looking at the altimeter.

RESULTS AND DISCUSSION

References (NASA TP-1250 and NASA CR-1535) show that pilots when flying simulated approaches have an altimeter mean dwell time of only between .3 to .6 seconds. In addition observation shows that the pilot looked at the left side of the altimeter even though the needle was pointing to the right side. This made necessary to re-analyse the dwell time and to divide the altimeter into three zones: left side, right side and window.

These data were taken from seven pilots who performed a total of 108 simulated approaches.

It was observed that with short dwell times the pilot gets only minimal information such as the direction of the needle orientation. The longer dwell times are associated with reading the needle value. During the approximately 180 seconds required for an approach the needle is on the left side for only 40 or 50 seconds (on the average 25% of the time). The pilot spends approximately 48% of the time in the altimeter on the left side. It is hypothesized that the pilot can determine right side needle position and/or its movement by looking at the left side.

Of great importance is the right side of the altimeter where the window stands. When the pilot looks in the drum area and the needle is overlapping the drum area, it is difficult to determine which piece of information he is reading.

While the drum pointer altimeter may not be the best available, all altimeters share to some degree the same problems. Each pilot has an individual scan pattern when checking the instruments which changes with instrument layout, aircraft, and flight conditions.

The basic time required to extract the desired information should be fairly constant across conditions for an instrument like the altimeter.

The results indicate that:

1. Drum and pointer misreads by pilots are fairly common.
2. It requires several fixations within the drum pointer altimeter to get all the information available.
3. The pilot can pick up relative needle position (right or left) in a quick glance (.1 sec.).

4. The total time spent looking at the altimeter drum is very small, 3% of the dwells within the altimeter, and pilots require .5 to .6 sec. to read the window.

Several improvements are indicated: 1/ to increase the size of the drum numbers (they are of the minimum size recommended in "HUMAN FACTORS & ENGINEERING AND DESIGN" Mc Cormick, Ernest j.), 2/ Using a counter or combination of drum counter, 3/ place the instruments where the pilots look most (on the left side of the altimeter). Some of these improvements are already included in some of the newer altimeters.

1.17 Additional Information.

1.17.1 Antennas Monte Oiz

On Monte Oiz top there was a field of antennas, with the following characteristics:

a) EUSKAL TELEBISTA

Year of construction	1982
Base altitude	1.000
Height	54 mts.
Channel	33 UHF
Frequency	567 to 573 MHz (2 Kw)
	104.4 MHz (1 Kw)
	103.2 MHz (1 Kw)
Markings	Red and White stripes
Lighting	Included
Notification to Aeronautical Authorities	There is no proof of it.

b) TELEVISION ESPAÑOLA (TVE)

Year of construction	1971
Base altitude	1.021
Height	31 mts.
Channel	30 UHF
Frequency	543 and 549 MHz (2 Kw.)
Markings	Red and white stripes
Lighting	not included
Notification to Aeronautical Authorities	Not required at the time of construction

c) COMMUNICATIONS AND SOUND

Year of construction	1981
Base altitude	1.018
Height	21 mts.
Frequency	164.450 MHz (15 w) 163.250 MHz (20 w) 164.275 MHz (10 w) 164.175 MHz (10 w) 157.650 MHz (10 w) 168.425 MHz (10 w)
Markings	None
Lighting	Not included
Notification to Aeronautical Authorities	There is no proof if it

d) IBERDUERO REPEATER

Year of construction	1979
Base altitude	1.014
Height	15 mts.
Frequency	7.156-7.205 GHz (300 mw) 7.352-7.401 GHz (300 mw) 7.338-7.387 GHz (300 mw)
Markings	Green color (painted).

Lighting	Not included
Notification to Aeronautical Authorities	There is no proof if it

e) ROAD AID (DYA)

Year of construction	1971
Base altitude	1.010
Height	19 mts.
Power	45 w
Frequency	169.300 MHz
Markings	Grey color (painted)
Lighting	Not included
Notification to Aeronautical Authorities	Not required at the time of construction.

1.17.2 Bilbao Airport Approach Chart

1.17.2.1 AIP España Approach Chart

A study on Bilbao Airport approach chart VOR/DME ILS-RWY 30, in force on February 19, 1985, was begun in 1980, in accordance with ICAO's DOC 8168-OPS/611/3 (Aircraft Operation), of 1971, duly updated.

For its preparation the available data were obtained: basically radio aids (type and coordinates) and chartography.

13 DME fix point was established (13 NM from VOR/DME BLV), located on radial 121 so that proceeding outbound the intermediate approach manoeuvre would begin at that point, moving outbound from radial 121 and performing the prescribed left turn

passing over 13 DME fix, heading 301, the final approach would begin here when the glide slope was intercepted.

The intermediate approach area was established in accordance with the said DOC-8168, outbound from 13 DME fix, being 8.5 NM long, and 8 NM wide (5 NM from the heading on the prescribed turn's side and 3 NM from the other side).

According to DOC-8168 the intermediate approach shall not be made at a height of under 300 meters (1000 feet) over any obstacle within its zone.

At the time the study on possible manoeuvres was performed, taking into account local topography, it was observed that Monte Oiz (1.027 meters), was a determining obstacle in fixing the minimum height for the intermediate approach, thus being established at 1327 meters (4354 feet).

Subsequently to the appropriate checks, the VOR/DME ILS RWY-30 chart was approved and published. It enters into force on November 14, 1981.

Monte Oiz's height did not figure on the approach chart. On the date of the accident the making of a new approach chart for Bilbao Airport was under study, in accordance with DOC-8168, 1982 Second Edition, replacing any previous editions since November 25, 1982.

1.17.2.2 Approach Chart of the Airline

According to AIP España. Monte Oiz's height did not figure either.

2. ANALYSIS

2.1 Flight history

Aircraft Boeing 727, registration EC-DDU of IBERIA Airlines, takes off from Madrid (Barajas) Airport at 07.47:00 hours, on 19 February, 1985, to perform scheduled flight IB-610, destined to Bilbao (Sondica) Airport.

There is no evidence of any abnormality in the prior preparation of the flight. It was the first flight the crew performed on that day, who had had, at least, a 24 hour rest period.

From 07.55:37 hours (31:27) (1) at which time the CVR recording starts, to 07.57:18 (29:54), the Copilot and the Flight Technical Officer hold a conversation in the cockpit relating service items, in which conversation the Captain does not intervene. At the said time a passenger cabin crew member enters the cockpit to whom the three technical crew members request coffee.

At 07.58:24 hours (28:39) the Captain informs Control (East Take-offs Sector in frequency 127.5), passing Arbancón NDB, leaving flight level one seven five. Control informs him to switch to frequency one three three eight five; once the communication was established, it informs: "WE ARE LEAVING ONE EIGHT FIVE FOR TWO FOUR ZERO IN COURSE TO DOMINGO". Later Control tells him to change to Sector Madrid, in frequency one three four three five.

(1) Note: Number in parenthesis show time in minutes and seconds for impact.

At 07.59:53 (27:10), contact is established with Sector Bilbao and the following communications take place until 08.00:13 hours (26:51):

C1 "MADRID IBERIA SIX ONE ZERO, GOOD MORNING."

LECM "SIX ONE ZERO MADRID, GOOD MORNING RADAR CONTACT. ¿WHAT LEVEL DO YOU WISH?

C1 "TWO SIX"

LECM "SIX ONE ZERO, AUTHORISED FOR FLIGHT LEVEL TWO SIX ZERO"

C1 "O.K. FOR TWO SIX ZERO. WE NOW LEAVE TWO ONE FIVE, THANK YOU."

LECM "RECEIVED"

F.D.R. (Flight Data Recorder) analysis shows that data on communications match the performance of the aircraft relating course, height and position.

There are not any other communications until it contacts the Airline's Operations at Bilbao.

While the aircraft is climbing to reach cruise level, unimportant conversations are held in the cockpit between the Copilot and the Flight Technical Officer; the Captain does not intervene in any of them.

At 08.02:18 hours (24:46) the Altitude Alert horn can be heard in the C.V.R., matching the system's warning which informs that they were, approximately, 900 ft. away from capturing flight level two six zero,

that was foreseen. Nineteen seconds later the Thrust Lever Back horn is heard, with the airplane at cruise level, probably as a result of switching the PDC selector from CLIMB to CRUISE, and the anemometer being selected at a speed inferior to that of the climb.

At 08.07:41 (19:22) the copilot contacts the Airline's Operations in Bilbao in order to provide flight data, giving the landing estimate and requesting airport meteorological information. Gives an approximate estimate of 17 minutes for landing. All communications from that moment, with Operations and Control Centers, are performed by the Copilot. The meteorological information received by Operations is the following: "WIND ONE HUNDRED AND TEN DEGREES, FOUR KNOTS, VISIBILITY FOUR KILOMETERS REDUCED BY FOG AND TWO OF CUMULUS AT TWO THOUSAND FIVE HUNDRED, FOUR OF STRATO CUMULUS AT FOUR THOUSAND, TEMPERATURE SEVEN, DEW POINT SEVEN AND QNH ONE THOUSAND AND TWENTY FIVE, ONE ZERO TWO FIVE."

At 08.09:29 hours (17:34), the following communication is established:

C2 "MADRID, SIX ONE ZERO READY FOR DESCENT."

LECM "SIX ONE ZERO, CLEARED FOR FLIGHT LEVEL ONE THREE ZERO, OVER. CORRECTION, ONE ZERO ZERO."

C2 "FOR ONE HUNDRED, COPIED. LEAVING TWO SIX."

Immediately the Altitude Alert System horn is heard, probably due to selection of level one zero zero to which they had been cleared.

Then a passenger cabin crew member enters. Though its sentence is not understood, by the Copilot's answer: "FIFTEEN MINUTES, SEVEN DEGREES FOG", it can be asserted that she requested information to transmit to the passengers, which she does via loud speaker in English and Spanish.

At 08.10:16 hours (16:48), until 08.11:01 hours (16:03), a conversation takes place in the cockpit, between a passenger cabin crew member and the three members of the technical crew, from which it can be deduced that she brings the coffees they requested earlier.

At 08.12:13 hours (14:51), some noises can be heard in the C.V.R. identified as the frequency selector, and immediately after the NDB-BIL morse signal is heard. No conversation is heard in the cockpit, though communications with other traffics are noticed which are in the same frequency with Control Madrid, until at 08.15:55 hours (11:09) it contacts the aircraft and the following communications take place:

LECM "IBERIA SIX ONE ZERO, CONTACT NOW BILBAO APPROACH. GOOD-BYE. ONE HUNDRED EIGHTEEN FIVE."

C2 "GOOD-BYE."

At 08.16:03 hours (11:00):

C2 "BILBAO TOWER, GOOD MORNING SIX ONE ZERO."

TWR "IBERIA SIX ONE ZERO, GOOD MORNING. GO AHEAD."

C2 "WE ARE LEAVING LEVEL ONE THREE FOR LEVEL ONE HUNDRED, TWENTY EIGHT OUT."

TWR "ROGER, IBERIA SIX ONE ZERO. ONE MOMENT PLEASE."

TWR "IBERIA SIX ONE ZERO, YOU CAN CONTINUE DESCENT FOR AN ILS APPROACH TO BILBAO RUNWAY THREE ZERO, WIND IS ONE HUNDRED DEGREES THREE KNOTS, QNH ONE ZERO TWO FIVE AND TRANSITION LEVEL SEVEN ZERO."

C2 "THANK YOU, DESCENDING TO SECTOR MINIMA, WITH ONE THOUSAND AND TWENTY FIVE."

TWR "CORRECT, ONE THOUSAND AND TWENTY FIVE, AND IF YOU WISH YOU CAN PROCEED DIRECT TO THE FIX."

08.16:54 (10:09) (ALTITUDE ALERT HORN)

C2 "WE ARE GOING TO MAKE THE... STANDARD MANOEUVRE."

TWR "ROGER, NOTIFY PASSING OVER THE VOR."

The sound of the Altitude Alert system horn is heard due to selection of level seven zero, which was the Sector Minimum and which coincided with the transition level.

At 08.17:49 hours (9:15) the Copilot says: "TEN THOUSAND DESCENDING.", and the Flight Technical Officer begins the reading of the ten thousand feet list which ends at 08.19:45 hours (7:18), remaining the seat belts. The voices of the Copilot and the Flight Technical Officer can be clearly heard in the C.V.R. but not that of the Captain.

At 08.20:23 hours (6:41), the Altitude Alert system horn is heard, which according to FDR data, it corresponds to the system warning bound for level seven zero.

At 08.20:32 hours (6:32), the Back Thrust horn is heard. The IAS was then of 260 knots. It is considered that the action of back thrust together with the decrease of the descent rate, is taken by the crew in order to decrease the speed so that they could begin the flaps sequence.

At 08.21:40 hours (5:24) the Copilot says: "TWO PLEASE", and the Flight Technical Officer reports, fourteen seconds later, "TWO GREEN, ONE NINE...MIN". Which correspond, respectively, to the request of two degrees of flaps and the announcement that they are symmetrically extended, and at the same time provides minimum speed for that flap setting.

At that moment the aircraft's heading was 006° to Bilbao VOR, at an approximate altitude of 7.100 feet and an IAS of 215 knots.

At 08.22:04 hours (05:00), the Copilot informs to TWR: "SEVEN THOUSAND FEET OVER THE VOR, IBERIA SIX ONE ZERO, STARTING THE MANOEUVRE.", this is the last communication of the aircraft. Immediately, TWR replies, "ROGER, SIX ONE ZERO.". When the Copilot begins his communication the aircraft's heading was 006°, its altitude was 7.000 feet and IAS of 211 knots. At the same time it receives the TWR's reply, it begins a right turn until heading 084°, and immediately, before the aircraft is stabilized, a new heading of 130° is selected.

During the turn, until reaching a heading of 125°, the aircraft held an altitude of 7.000 feet and an IAS of 204 knots. During this period, 12 seconds before leaving 7.000 feet, the Altitude Alert system

horn is heard, which is considered to correspond to the 5.000 feet setting, according to the approach chart, to subsequent aircraft performance and warnings of the Altitude Alert system.

At 08.23:14 hours (03:50) they leave 7.000 feet.

From the time they left 7.000 feet to when the capture 5.000 feet -at 08.25:14 hours (01:50)-, the aircraft descends at a rate of 1.000 ft/min., the IAS varies from 198 to 214 knots, and the heading, after reaching 130°, it changes to 113°, another correction is made later to 124°, and when reaching 5.000 feet the heading was of 117°. During the descent from 7.000 to 5.000 feet, at 08.24:00 hours (03:40), the Copilot is heard in the C.V.R. to say, "WE SET SEAT BELTS NOW", action he performs immediately since the passenger warning bell is also heard. Eleven seconds later it is heard, in english and spanish, the request to the passengers to fasten their seat belts.

At 08.24:27 hours (02:37), the Altitude Alert system horn is heard, coinciding with the 900 for 5.000 feet warning, which it is considered to be selected before leaving 7.000 feet when the horn was heard.

At 08.25:14 hours (01:50) the aircraft captures 5.000 feet, and until it leaves these, 25 seconds later, the heading varies from 117° to 124°, the IAS decreases from 209 to 203 Knots. At 08.25:30 hours (01:34), that is, nine second before leaving 5.000 feet, the Altitude Alert system horn is heard, probably when selecting 4.300 feet.

At 08.25:39 hours (01:25), the aircraft leaves 5.000 feet with a descent rate of 1.500 ft/min., which it holds until reaching an altitude of 3.870 feet forty eight seconds later, changing to a rate of

approximately 700 ft/min., which it holds until the impact. From the time it leaves 5.000 feet to the collision, the speed is maintained between 203 to 213 knots.

Five seconds after leaving 5.000 feet it begins a change of heading to the left, leading it from 124° to 078° at the moment of the descent rate modification and which continues to vary slightly until reaching 076° ten seconds before the impact; immediately after that it begins a right turn until reaching a heading of 096°, when the impact against the base of the television antennas takes place.

Forty one seconds after leaving 5.000 feet and forty four before the impact, at an altitude of 4.040 feet, the Altitude Alert system horn is heard, which according to the logical operation of the same, it should only be heard 900 feet before the selected altitude and/or 300 feet after surpassing the same. One must suppose that they had selected 4.300 feet, since a selection of 3.100 feet that would make the horn to sound in approach mode (900 feet to the selected altitude), does not match with any of the values in the chart. On the contrary, the 4.300 feet setting, does fall within logic since being the setting between 5.000 feet and 4.300 feet inferior in 1.000 feet, the system's horn does not sound in approach mode, doing so at approximately 4.000 feet, in deviation mode (300 feet from the selected altitude).

At 08.26:54 hours (00:10) coinciding with the beginning of the right turn, the Copilot says:

"FIVE PLEASE"

Two seconds later:

"MINIMUM, ONE SIX... THREE. FOUR THOUSAND THREE HUNDRED, CURVE."

The first sentence corresponds to the request of five degrees of flaps. The second to a comment or reading of the minimum speed for that setting and minimum height for the curve of the manoeuvre, according to the interpretation of the chart, rounding the altitude (4.354 feet) by defect or because of having it read in the Altitude Alert system windows. Immediately after the Copilot ends the phrase, at 08.27:04 hours, the aircraft's impact sound against the base of the antennas can be heard.

2.2 Crew behaviour

2.2.1 Pilot in command

When several stops are going to be performed on the same day, it is common practice that each crew member carries out a "jump", that is to say that the pilot performing the take off performs the landing as well.

According to the C.V.R. the communications during the climb phase were performed by the Captain, so it can be supposed that the Captain was not the pilot in command, in spite of the fact of not giving the 1.000 feet to level call. Except for brief comments he does not participate in any of the conversations nor does he make any verbal comments to the Copilot regarding the course of the operation.

Though communications with Operations of the Airline at Bilbao and later with Control Madrid and TWR Bilbao are performed by the Copilot, these are quite brief and take place during the cruise and descent flight phases, and in addition the frequencies used are fairly free of communications with other traffic.

Nevertheless it seems that the level or altitude settings in the Altitude Alert system were performed by the Captain. It could be a way of conducting the operation without the need for audible instructions. The Altitude Alert system setting and the warnings of the said system on the selected levels or altitudes, could have prevented him from performing the 1,000 feet Call-Outs.

It is considered that it was the Captain who performed the setting and locking of the Altitude Alert system, since according to statements of the Airline's crew members, this was his usual practice. In addition there were two times in which the system's horn is heard due to a new setting and it is not easily understood whether at the same time the Copilot is transmitting, a new setting is being locked on the Altitude Alert system, because of its location on the central pedestal which is not easily accessible.

The estimates for the landing given to Operations of the Airline and to the passenger cabin crew member, seventeen and fifteen minutes respectively (given out with an interval of two minutes), are provided by the Copilot.

The request for flap setting is performed normally by the pilot in command. In this flight it is the Copilot who requests two and five degrees of flaps.

The action of turning on the seat belt switch coincides with the time in which the Copilot says, "WE SET SEAT BELTS NOW". Taking into account that it was the item remaining to complete the 10.000 feet check list and that this comment was not made as a question, this action is usually performed by the pilot in command.

In view of the above it can be deduced hat the Copilot was the pilot in command.

2.2.2 Descent from cruise level to 5.000 feet

According to data obtained from F.D.R., the correlation in time with the C.V.R. and the reconstruction of the trajectory, it can be determined that the Copilot, after surpassing the point DOMINGO at cruise flight level and once the clearance to begin its descent was obtained from control, it maintains speed, heading and descent rate in accordance with those appropriate for the operation of this part of the flight.

Its rates from cruise level are 2.500 ft/min., to level 190 approximately, somewhat inferior to 2.000 ft/min., to level 100 approximately, where the rate is lowered to 750 ft/min., until the Altitude Alert system horn is heard (900 feet to 7.000 feet, the last selected altitude), at which time the rate is reduced to 600 ft/min., and almost simultaneously the thrust levers at moved back in order to reduce the IAS which at that time was of 260 knots, and thus reaching 210 knots at 7.000 feet.

Communications with Control Madrid and TWR Bilbao correspond perfectly with the levels left or captured by the aircraft.

Selections in the Altitude Alert system are performed immediately after receiving Control clearances for a new level.

When the Copilot informs TWR that they have reached 7.000 feet, the aircraft is in fact at that altitude, at about 4 NM from the VOR and immediately starts the right turn in order to capture an outbound heading; when it ends the turn it maintains a trajectory fairly parallel to the appropriate radial, apparently converging towards NDB-BIL.

Nine seconds before leaving 7.000 feet, the Altitude Alert system horn is heard in the CVR, corresponding to 5.000 feet selection, altitude to hold on arriving to the 13 DME fix. Later on its descent to 5.000 feet, 900 feet to that altitude, the Altitude Alert system horn is heard again. This warning matches the system's performance on its approach mode to the selected altitude.

The descent rate between 7.000 to 5.000 feet is of 1.000 ft/min.

2.2.3 Performance from 5.000 feet to the impact.

Once it was established at 5.000 feet and before leaving that altitude, the Altitude Alert system horn is heard as a result of a new selection.

According to the Altitude Alert system's characteristics, values under hundreds of feet can not be selected, reason by which an altitude of 4.400 feet should have been selected, since the minimum altitude indicated on the chart is of 4.354 feet.

At or close to 13 DME fix the aircraft begins the descent, as well as a left turn heading 076°, established in the chart for the straight section of the procedure turn.

Taking into account that the security zone of the intermediate approach begins at the fix going outbound, and though the established manoeuvre shows that an outbound trajectory should be maintained until reaching the minimum altitude, the beginning of the procedure turn at that point may be considered as acceptable.

From the time the aircraft leaves 5.000 feet a descent rate of 1.500 ft/min.is maintained, for 48 seconds, which makes it reach an altitude of 3.870 feet, switching then to a descent rate of about 700 ft/min., which it maintains for 37 seconds, until the time of the impact.

2.2.3.1 Flight phase performed below the minimum altitude of the intermediate approach manoeuvre.

Since the CVR did not register any conversation (from the moment just before leaving 5000 feet, until the request made by the copilot for 5° flaps, 10 seconds before the impact) showing the crew's intention to perform this phase of the flight in the way is was finally carried out, the motives which may have induced the crew to fly inadvertantly below the manoeuvre's minimum altitude must be analysed.

In accordance with the analysis performed, this situation could have been produced as a result of the following:

a) erroneous action as a response to false or mistaken knowledge of the actual situation, which is agravated by:

b) response to the Altitude Alert System warnings, and

c) a misread of the altimeter.

a) on arriving to the point of start of the intermediate approach manoeuvre, it is only necessary to descent 600 feet in case of a 4.400 feet selection on the Altitude Alert System or 700 feet for a selection of 4.300 feet which seems to be the one chosen by the crew.

Taking into account that the descent rates previously studied, except when leaving cruise level and up to level 100, were lower to 1.500 feet/minute; that in order to capture the intermediate approach minimum altitude it had all the time available for the procedure turn or at least the time available for the sector prior to the curve of the same; that this starts ten seconds before the impact and seventy-five seconds after leaving 5.000 feet, this descent rate can be explained because the Copilot would have considered that he was starting it at an altitude other than 5.000 feet.

At the time of the accident it was not unusual when bound for Bilbao to proceed direct to the fix 13 DME, either because the crew requested it or because the TWR informed accordingly traffic conditions permitting. The manoeuvre direct to the fix avoided the pass over Bilbao VOR, thus saving time, with no detriment on security, as long as it did not descent below the sector minimum altitude, which was of 7.000 feet.

In this flight it is the TWR who informs to the aircraft, when leaving level one three zero and at 28 miles from the VOR, that is 3 miles away from the sector's limit, that it can continue its descent for ILS approach and that it can proceed direct to the fix if so was its wish.

From the Copilot's reply and subsequent comments made in the cockpit, it could be deduced that the Copilot's intention was to go direct to the fix, but probably because of a sign or gesture made by the Captain, he informs they are going to perform the standard maneouvre.

Then there could take place a mental conflict between the Copilot's wish to perform a shorter flight for which the TWR had granted with the clearance, and the Captain's instructions to perform the standard manoeuvre. The difference between these two manoeuvres lies in that going straight to the fix requires to reach the same at an altitude of 7.000 feet, while the standard manoeuvre allows for an altitude of 5.000 feet at the same point.

Consequently, for a selection of 4.300 feet on the Altitude Alert system, one must descent 2.700 feet and 700 feet for the first and second manoeuvre while performing the intermediate approach maneouvre.

The Captain's selection on the Altitude Alert system, and the fact that he did not provide the 1.000 feet call-outs for level, together with the continuous silence in the cockpit, mainly during the last six minutes of the flight, may have caused that when the aircraft was over the 13 DME fix (taking into account that they were cleared though they refused to do so) it induced the Copilot to consider that he had arrived to this point following the manoeuvre which he had mentally planned thus acting from then on as if he were at an altitude of 7.000 feet, minimum altitude for the 13 DME fix when was proceeding direct to it. And consequently descending at a rate of 1.500 ft/min in order to capture the intermediate approach manoeuvre altitude.

b) The Altitude Alert system has two type of warnings, acoustic and light warnings. If the ALT SEL key, located on the central pedestal, on the A/P control panel, is pressed, when the selected altitude is captured only the warnings prior to capture will be activated (as long as the selection is performed with a difference of 1.000 feet or more, between the actual altitude and the selected altitude).

If the system selection is performed with a difference inferior to 1.000 feet and it is not reset, the system's light will continue to flash corresponding to the previous selection, which shall go off 300 feet before the selected altitude, and according to the studies carried out it will capture in case it is armed. If not, it will continue its descent and will provide an acoustic warning 300 feet after the selected altitude and at the same time the leaving light shall glow until 900 feet after it is surpassed, when it will go off.

According to the FDR, CVR and the study of the remains it can be asserted that: nine seconds before leaving 5.000 feet there is a selection in the Altitude Alert system; the equipment was found with the thousand units blocked, showing number four; the hundred units was set at three and only allowed movement between two and three; the system's horn only sounds when the aircraft is at an altitude very close to 4.000 feet.

Action performed on the system and its response could have been as follows:

1. The Captain selects 4.300 feet in the Altitude Alert system, inadvertently he could not have pressed the "ALT SEL" Key or, once pressed, one of the pilots pressed it again, unarming the system and thus not capturing.

2. The Copilot had his left hand on the central pedestal, preventing the Captain from the normal action of pressing the "ALT SEL" key, and that when he pressed it, the margin for capture would have been surpassed.

3. The system had been working correctly in previous captures (7.000 and 5.000 feet) though malfunction cannot be discarded.

In any case, when leaving 5.000 feet the first acoustic signal provided by the system, because of selecting a difference inferior to 1.000 feet, would be the acoustic warning corresponding to 300 feet after the selected altitude and its warning light located on the front panel would flash. This would take place at 4.000 feet and the light wuold have continued to flash until 3.400 feet. The light warning may not be significant and may not carry out its alarm function, since the indicator is the same for approach as well as for deviation from the selected altitude.

Consequently the Copilot would have interpreted the acoustic warning of the Altitude Alert system, as the warning corresponding to the approach to the selected altitude. His action is similar to that performed when he heard the acoustic warning towards 7.000 feet and was going to begin a turn over the VOR, decreasing the

descent rate, which he maintain until the impact, waiting for the A/P to capture 4.300 feet, which was the selected altitude.

c) This aircraft was equiped with drum and needle altimeters. The instrument is located at a distance of approximately 70 cm. from the pilot's eyes, slightly to its right, its diameter is of 69.7 milimeters, it is divided into ten "one hundred" sectors, numbered from zero to nine and with "twenty feet" subdivisions. On the right side semicircle it has a window in which appear from top to bottom in a decreasing order the thousands of feet numbers. The said window which provides for a vision of up to four number has on its right side a fixed indicator arrow.

To read it, it is necessary to take the smaller number of the two close to the indicator arrow on the thousands of feet window adding then hundreds and tens of feet indicated by the arrow.

The results of the tests carried out on drum and needle altimeter misreads, indicate that pilots look seldom to the thousands of feet window (apparently because it is difficult to read); the mean dwel time for the reading of the altitude is 0'6 sec..

A study performed by NASA in order to discover the percentage of pilots that had misread or had seen others misread the drum altimeter provides the following data: out of 169 pilots, 137 stated that they had misread the altimeter and 134 stated that they had seen other pilots misread it (85% of each group said it had happened more than once).

Others studies performed by NASA consider that: the pilot's movements are forecasted by reason of what they know or think they know about the aircrafts position. Their knowledge on the altitude at a given moment and with a constant descent rate may result in a slow increase of uncertainty, which might make them forget their need to look at the altimeter.

This confident position is supported by the fact that the flight is performed in automatic mode and as seen in the aforementioned studies, while in automatic flight it is least likely to detect a significant deviation of the airplane.

It is convenient to recall the pilots' comments, according to the studies of reference, relating the drum altimeter:

"This altimeter takes more concentration than should be necessary to to read it accurately".

"The window is a complication on the instrument and is quite small, often requiring a doble look and diverting attention from the needle. Other instruments require only a single point of visual attention to comprehend and do not divert, slow, or complicate the checking of the instruments".

"Misreads seemed to always occur always at the lower altitude when attention is split between more activities".

"The more stressful situations produced more misreads".

"A quick glance after (a short period of time) can usually induce a misreading of 1.000 feet off if the barrel drum is halfway between thousands".

Taking into account that the aircraft is 55 seconds below the selected altitude and thus is 57 seconds below the manoeuvre protection limits, it makes one think that any reading of the altimeter should have been performed with the only reference of the altimeters needle, with no specific fixation on the thousands of feet window since a correct reading would have indicated during the first thirty seconds after leaving 5.000 feet, its closeness to 4.300 feet (selected altitude on the Altitude Alert system, altitude to which the Copilot makes reference three seconds before the impact) and subsequently, that it was flying below the said altitude.

3.- CONCLUSIONS

3.1. Deductions

a) The Captain and the rest of the crew were adequately qualified and experienced.

b) The Controller was adequately qualified, experienced and physically fit.

c) The aircraft held valid Airworthiness, Registration and Maintenance Certificates. The files show that it had been maintained according to the authorised maintenance program.

d) The navigation and approach aids were working correctly, according to the checks performed.

e) There is no evidence of malfunction in the ATC communications equipment.

f) The investigation did not show evidence of abnormality in the functioning of the engines and aircraft systems.

g) The weight and center of gravity were within established limits.

h) The aircraft flew, during the last 57 seconds, below the established altitude for the manoeuvre it was performing.

i) The crew, according to the flight's development did not perform the altitude checks correctly or its readings were erroneous.

j) The Altitude Alert system functioning philosophy does not allow for the crew to relax its surveillance over the flight altitude, confident that the A/P will capture the selected altitude.

k) The crew rounded the number corresponding to an altitude of 4.354 feet in the selection on the Altitude Alert system by defect, to 4.300 feet, instead of doing it in excess to 4.400 feet.

l) There was not enough supervision of the manoeuvre by the pilot who was not in command, neither did he provided the 1.000 feet call outs.

m) The television antennas' base surpassed the mountain's top in 28 metres, even though it did not figure on the chart it was a determining obstacle in order to calculate the altitude of security of the intermediate approach manoeuvre protection area.

3.2. Cause

Their confidence on the automatic capture performed by the Altitude Alert system, the misinterpretation of its warnings, as well as a probable misreading of the altimeter made the crew to fly below the safety altitude, colliding into the television antennas' base, thus losing the left wing, falling to the ground with no possible control of the aircraft.

4.- Recommendations

a) Reiterate the technical crews the necessity and importance of performing the call outs of minimum altitudes (authorised by the ATC, the sector's, over the radio aid, in the procedure turn, etc...) by the pilot who is not in command.

b) Reiterate and instruct the technical crews on the importance and necessity of training relating cockpit cordination and organisation of resources of the same.

c) Substitute the drum and needle altimeters with other models which avoid, as far as possible, misreadings.

d) Remind the technical crews of the need for a more careful reading of the thousands window in drum and needle altimeters.

e) Study the modification in the Altitude Alert equipment of the audio warning corresponding to the abandoning of the selected altitude, for and intermittent audio warning, synchronised with the system's light warning and that the automatic capture arming be permanent (except when the A/P is in Auto G/S mode).

f) Urge the appropriate aeronautical authority to accelerate the modification of aeronautical charts to comply with ICAO Doc. 8168 ruling, at present in force.

g) Insist on the technical crews to place on the Altitude Alert system windows the altitudes which figure on the approach charts, always rounding to the higher hundred.

h) Urge the appropriate aeronautical authority to assure periodic inspection systems for the specific zones that include protection surfaces, in order to avoid the appearance of obstacles that surpass the maximum permitted altitudes.

A N E X O : A

TRANSCRIPCION DEL CVR .

HORA	ORIGEN	COMUNICACIONES	CONVERSACION CABINA
		********	
07.59:42	LECM	IBERIA SEIS UNO CERO, LLAME A MADRID, UNO TRES CUATRO TRES CINCO	
07.59:45	CI	UNO TRES CUATRO TRES CINCO HASTA LUEGO	
07.59:53	CI	MADRID, IBERIA SEIS UNO CERO BUENOS DIAS	
07.59:59	LECM	SEIS UNO CERO, MADRID, BUENOS DIAS CONTACTO RADAR, ¿QUE NIVEL DESEA?	
08.00:03	CI	DOS SEIS	
08.00:05	LECM	SEIS UNO CERO, AUTORI-ZADO A NIVEL DE VUELO DOS SEIS CERO	
08.00:08	CI	OKEY, PARA DOS SEIS CERO ABANDONAMOS AHORA DOS UNO CINCO, GRACIAS	
08.00:13	LECM	RECIBIDO	
			**********
08.02:19			(BOCINA ALTITUD ALERT)
			**********
08.02:37			(BOCINA DE PALANCA DE GASES ATRAS)
		**********	
08.07:41	C2	BILBAO OPERACIONES SEIS UNO CERO	
08.07:45	OPS-IB	SEIS UNO CERO, BUENOS DIAS, ADELANTE PARA BIL BAO... (ilegible)	
08.07:48	C2		PASAJE A BILBAO
	C3		MOMENTO, CIENTO CUARENTA Y UNO
08.07:51	C2	EL COMANDANTE PATIÑO DELTA DELTA UNION CON, CIENTO CUARENTA Y UN PASAJEROS, TRIPULACION STANDARD ESTIMADA LA TOMA DE TIERRA APROXI-MADAMENTE A Y VEINTICIN CO. ¿ME DAS POR FAVOR EL ULTIMO?. ¿ERES JUAN MARI?	
	OPS-IB	NO, NEGATIVO, NO SOY JUAN MARI, AHORA SE PONE ¿PUEDE COPIAR?	
08.08:05	OPS-IB	IBERIA SEIS UNO CERO DE COORDINACION BILBAO ¿PUEDE COPIAR EL TIEMPO DE BILBAO DE LAS SIETE TREINTA ZETA?	
08.08:28	C2	PUEDO, PUEDO ADELANTE	
08.08:30	OPS-IB	VIENTO CIENTO DIEZ GRA-DOS, CUATRO NUDOS, VISI-BILIDAD CUATRO KILOMETROS REDUCIDO POR NIEBLA Y DOS DE CUMULOS A DOS MIL QUI	

HORA	ORIGEN	COMUNICACIONES	CONVERSACION CABINA
		NIENTOS, CUATRO DE ESTRA TOCUMULOS A CUATRO MIL, TEMPERATURA SIETE, PUNTO DE ROCIO SIETE Y QNH MIL VEINTICINCO, UNO CERO DOS CINCO, CAMBIO	
08.08:46	C2	OIDO, HASTA AHORA	
08.09:06	C2		¿PONEMOS SESENTA Y SEIS O SESENTA Y CUATRO?
08.09:10	C3		VAMOS A PESAR SESENTA Y CUATRO
08.09:23	C3		EMILIO, DIME TU NUMERO, POR FAVOR
08.09:26	C2		VEINTIOCHO CERO OCHO TRES SEIS
08.09:29	C2	MADRID, SEIS UNO CERO LISTO DESCENSO.	
08.09:31	LECM	SEIS UNO CERO, AUTORIZADO A NIVEL DE VUELO UNO TRES (entracortado) CERO, CAMBIO. CORRECCION, UNO CERO CERO	
08.09:37	C2	PARA NIVEL CIEN, COPIADO. LIBRANDO DOS SEIS	
08.09:40			(BOCINA ALTITUD ALERT)
	AUX		(Ilegible muy débil)
08.09:47	C2		QUINCE MINUTOS SIETE GRADOS NEBLINA
08.09:51			(BOCINA PALANCA DE GASES ATRAS)
08.09:57	S/C		SEÑORES PASAJEROS, DENTRO DE QUINCE MINUTOS TOMAREMOS TIERRA EN EL AEROPUERTO DE BILBAO, LA TEMPERATURA ES DE SIETE GRADOS CENTIGRADOS Y HAY NIEBLINA. GRACIAS. LADIES AND GENTLEMEN IN FIFTEEN MINUTES TIME, WE'LL LAND AT BILBAO WHICH TEMPERATURE IS SEVEN DEGREES CENTIGRADES AND IT'S FOGGY. THANK YOU
			**********
08.12:13			(RUIDO DE SELECCION DE FRECUENCIAS)
08.12:18			(SEÑAL MORSE DEL NDB: BIL)
		**********	
08.15:55	LECM	IBERIA SEIS UNO CERO COMUNIQUE AHORA BILBAO APROXIMACION, HASTA LUEGO. CIEN ... DIECIOCHO CINCO.	
08.16:00	C2	HASTA LUEGO	
08.16:03	C2	BILBAO TORRE BUENOS DIAS SEIS UNO CERO	
08.16:06	TWR	IBERIA SEIS UNO CERO BUENOS DIAS ADELANTE	
08.16:09	C2	ESTAMOS LIBRANDO NIVEL UNO TRES PARA NIVEL CIEN, VEINTIOCHO FUERA	
08.16:13	TWR	RECIBIDO IBERIA SEIS UNO CERO, UN MOMENTITO POR FAVOR	

HORA	ORIGEN	COMUNICACIONES	CONVERSACION CABINA
08.16:33	TWR	IBERIA SEIS UNO CERO PUE DE CONTINUAR DESCENSO, PARA APROXIMACION ILS A BILBAO PISTA TRES CERO, EL VIENTO ES DE CIEN GRADOS TRES NUDOS, QNH UNO CERO DOS CINCO Y NI VEL DE TRANSICION SIETE CERO	
08.16:44	C2	GRACIAS, DESCENDIENDO PARA MINIMOS DEL SECTOR CON MIL VEINTICINCO	
08.16:48	TWR	CORRECTO, MIL VEINTICIN CO Y SI LO DESEA PUEDE PROCEDER DIRECTO AL FIJO	
08.16:54			(BOCINA ALTITUD ALERT)
08.16:55	C2	VAMOS A HACER LA MANIO- BRA ..... ESTANDARD	
08.16:57	TWR	RECIBIDO, NOTIFIQUE PA- SANDO EL VOR	
08.17:01	C2		¿TE HAN PAGAO? ¿TE HAN PAGAO LOS ATRASOS? HACEMOS LA MANIOBRA ESTANDAR ENTONCES
	C1		SI
08.17:07	C2		VALE (RISAS)
08.17:15			EL OTRO DIA VOLE, AYER, ANTEAYER CON SANTIAGO DE LA PAZ, LO MISMO. ES OTRO DE LOS ENCARTAOS ... TAMBIEN, EN LA MISMA SITUACION
08.17:30	C2		PUES ESO. LO QUE TU
			(SEÑAL MORSE DEL NDB: BIL Y DEL VOR: BLV)
08.17:41	C2		BUENO, VAMOS A ESPERAR PORQUE COMO NOS VAMOS A DAR (CARRASPEO)
08.17:45	C2		LO QUE PUEDO HACER ES MIL VEINTICINCO AQUI
08.17:49	C2		DIEZ MIL BAJANDO
08.17:52	C3		PUES MINIMUM SAFE
	C2		PENDIENTE DE LOS CINTURONES, PORQUE COMO VAMOS A ...
	C3		ANTI-ICE
08.17:57	C2		PUES SIETE MIL QUE ESTA PUESTO,
	C2		ANTI-ICE CLOSED
	C3		GO AROUND, EPR V.REF AUTOMATICO. SESENTA Y CUATRO MIL KILOS VELOCIDAD VEINTIOCHO; TREINTA Y NUEVE SIETE SIETE
08.18:06	C2		AQUI, BUGS SET
	N/I		(SI o SET)
08.18:12	C3		VEINTIOCHO ... TREINTA Y NUEVE SIETE SIETE
08.18:20	C3		GALLEY OFF, FUEL SET FOR LANDING, HYDRAULICS PRESSURE AND QUANTITY NORMAL, PRESSURITATION AND COOLING DOORS SET, CIRCUIT BRAKERS CHECKED
08.18:31	C3		MISSED APROACH

HORA	ORIGEN	COMUNICACIONES	CONVERSACION CABINA
08.18:34	C2		DIRECTO AL BRAVO LIMA OSCAR QUE ESTA PUESTO EN EL DOS, CON UN VIRAJE A LA DERECHA RUMBO TRES CUATRO CERO, ASCENDER A CINCO MIL PIES, VOLVER A ...
08.19:20	C2		AAH! MIL VEINTICINCO DIJO, VERDAD?
	C3		SI
08.19:29	N/I		NO SE VE ... (ilegible)
08.19:32	C2		SET AND CROSS CHECKED
	C3		FLIGHT INSTRUMENTS FLIGHT DIRECTORS
08.19:38	C2		¡FOR APPROACH!
	C3		INBOARD LANDING LIGHTS
			(CHASQUIDO INTERRUPTORES LUCES)
	C3		FUEL, HEAT OFF, DESCEND CHECK LIST COMPLETED A FALTA DE CINTURONES.
08.20:23			(BOCINA ALTITUD ALERT)
08.20:29			(BOCINA GASES ATRAS)
08.21:17	CI		HAY QUE VER, PORQUE HAY QUE VER (con entonación musical)
08.21:40	C2		DOS POR FAVOR
08.21:54	C3		DOS VERDE, UNO NUEVE, ... MIN
08.22:04	C2	SIETE MIL PIES SOBRE EL VOR, IBERIA SEIS UNO CERO INICIANDO MANIOBRA	
08.22:07	TWR	RECIBIDO SEIS UNO CERO	
08.22:09	BA8ID	SPEED BIRD EIGHT ONE DELTA, START CLEARANCE TO LONDON GATWICK	
08.22:15	TWR	SPEED BIRD EIGHT ONE DELTA ROGER, STAND BY CLEARANCE ON REQUEST	
08.22:18	BA8ID	OKEY	
08.22:40			(RUIDO DE COMPENSADOR)
08.23:02			(BOCINA DE ALTITUD ALERT)
08.23:59	C2		PONEMOS CINTURONES YA
08.24:00			(TIMBRE AVISO A PASAJEROS)
08.24:12	AUX		SEÑORES PASAJEROS, POR FAVOR ABROCHENSE LOS CINTURONES DE SEGURIDAD. LADIES AND GENTLEMEN, WILL YOU PLEASE FASTEN YOUR SAFETY BELT, THANK YOU
08.24:27			(BOCINA ALTITUD ALERT)
			(SEÑALES MORSE DE: BLV, VOR, DME Y NDB: BIL)
08.25:30	BA8ID	TOWER, SPEED BIRD EIGHT ONE DELTA, READY TO START MUCH DELAY?.	(BOCINA ALTITUD ALERT)
08.25:33	TWR	NEGATIVE SIR, JUST STANDING-BY FOR YOUR ATC CLEARANCE	
08.25:42	BA8ID	CAN WE START UP AND TAKE THE CLEARANCE TAXIING OUT?	

HORA	ORIGEN	COMUNICACIONES	CONVERSACION CABINA
08.25:46	TWR	AFFIRMATIVE, SIR	
08.25:48	BA81D	THANK YOU	
08.26:20			(BOCINA DE ALTITUD ALERT)
08.26:54	C2		CINCO POR FAVOR
08.26:57	C2		MINIMO, UNO SEIS ... TRES. CUATRO MIL TRESCIENTOS, CURVA
08.27:04		***(RUIDO DE IMPACTO)***	
			(A CONTINUACION SE PRODUCEN RUIDOS Y VOCES NO IDENTIFICADAS)
08.27:14		*FIN DE LA GRABACION*	

A N E X O : B

CARTA DE APROXIMACION POR INSTRUMENTOS OACI

INSTRUMENT APPROACH CHART ICAO

VOR/DME ILS RWY-30

BILBAO

BILBAO APROX/APPROACH	RODADURA/GROUND CONTROL	BILBAO TORRE/TOWER	ELEV:
120.7 MHZ	121.7 MHZ	118.5 MHZ 121.5 & 243.0 MHZ EMERG 139.3 MHZ & 257.8 MHZ MIL	42 138'

MNM SECT. ALT
1500
5000' 25 NM

MIN. SECT. ALT.
1350
4500' 25 NM

VAR 6° W

NDB
370 BLO

VOR/DME
115.9 BLV
DME 106

ILS
LLZ 110.3 IBL
GP 335

MM
75

OM
75

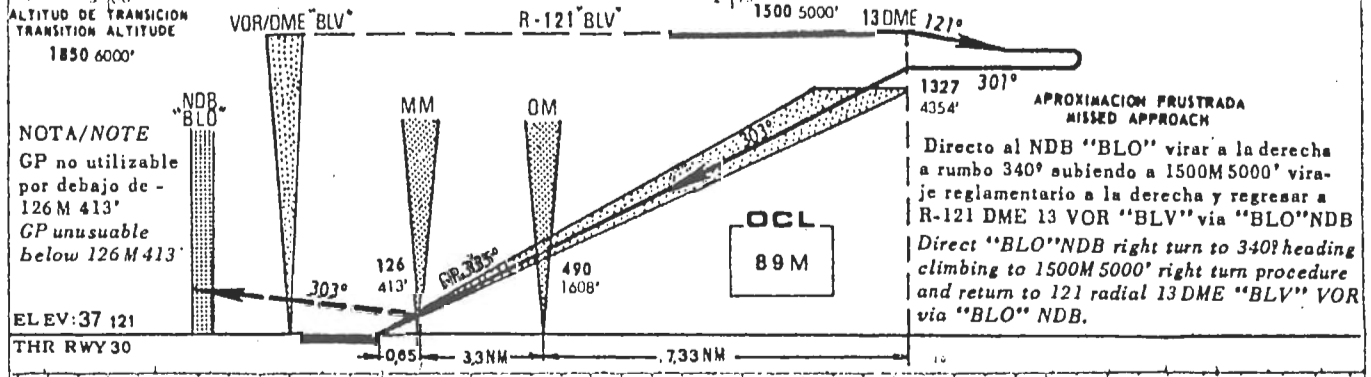
MNM SECT ALT
2150
7000' 25 NM

LOS RUMBOS SON MAGNETICOS
BEARINGS ARE MAGNETIC

ALTITUDES SOBRE EL NIVEL DEL MAR m - 300
ALTITUDES ABOVE SEA LEVEL ft. -1000'

ESCALA/SCALE 1:250.000

ALTITUD DE TRANSICION
TRANSITION ALTITUDE
1850 6000'



NOTA/*NOTE*

GP no utilizable por debajo de - 126 M 413'

GP unusuable below 126 M 413'

APROXIMACION FRUSTRADA
MISSED APPROACH

Directo al NDB "BLO" virar a la derecha a rumbo 340° subiendo a 1500M 5000' viraje reglamentario a la derecha y regresar a R-121 DME 13 VOR "BLV" via "BLO"NDB

Direct "BLO"NDB right turn to 340° heading climbing to 1500M 5000' right turn procedure and return to 121 radial 13 DME "BLV" VOR via "BLO" NDB.

ATERRIZAJE LANDG		ALT MIN	TECHO CEILING	VIS.		ALT MIN	TECHO CEILING	VIS.
DIRECTO STRAIGHT IN	DIA DAY	126 413'	90 295'	0.8 KM	NOCHE NIGHT	126 413'	90 295'	0.8 KM
NO DIRECTO CIRCLING	DIA DAY	460 1510'	420 1380'	2.4KM	NOCHE NIGHT	460 1510'	420 1380'	2.4KM

DESDE OM A LA PISTA — FROM OM TO RWY 30 7,4KM = 4 NM

ATS	90	110	125	140	160	180
KPH	167	204	231	250	296	333
MIN. SEC.	2-40	2-11	1-55	1-43	1-30	1-20

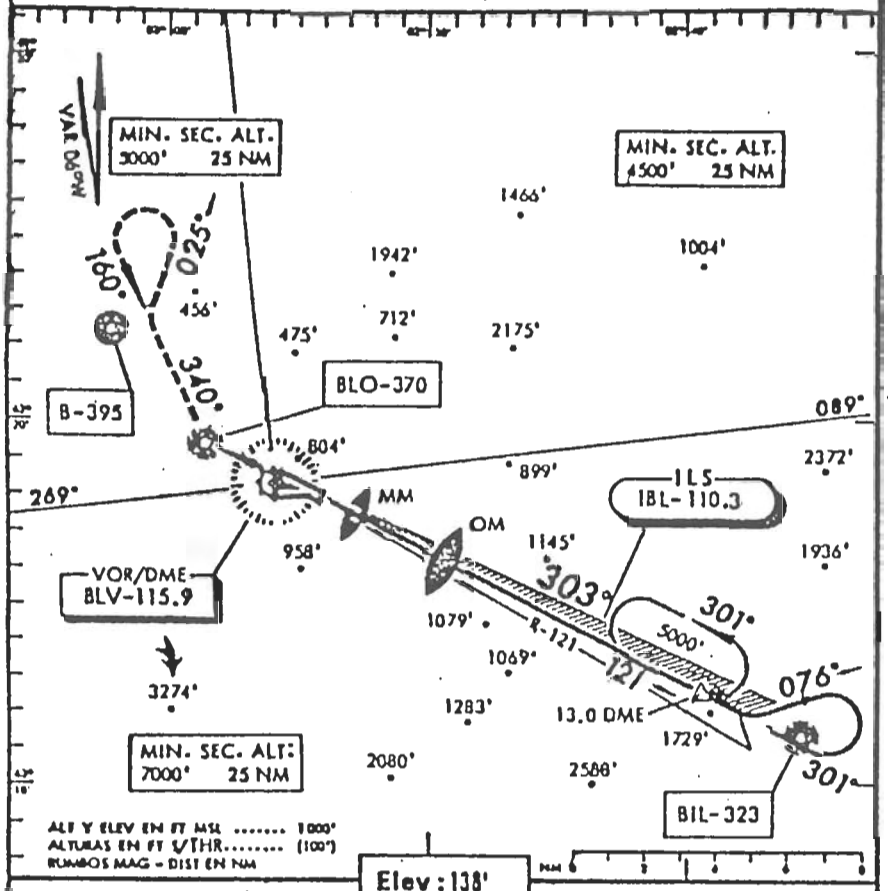
B-1 IBERIA VOR/DME+ S 30

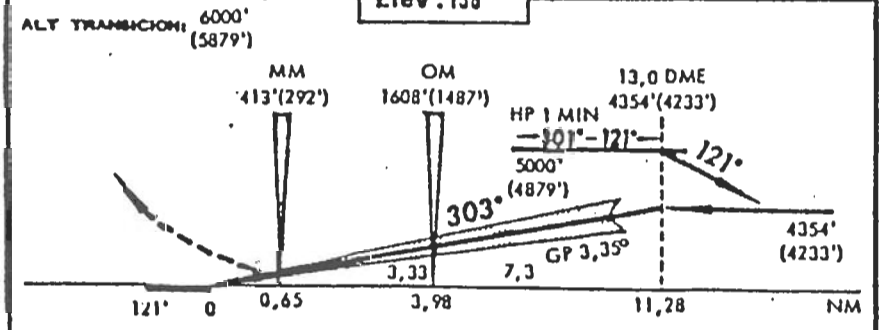
IL L 110.3)

TWR: 118.50
APP: 120.70
VDF.
GND: 121.70

GCA:
PAR:
SRE:
ATIS:

BILBAO ESPAÑA





APROXIMACION FRUSTRADA:

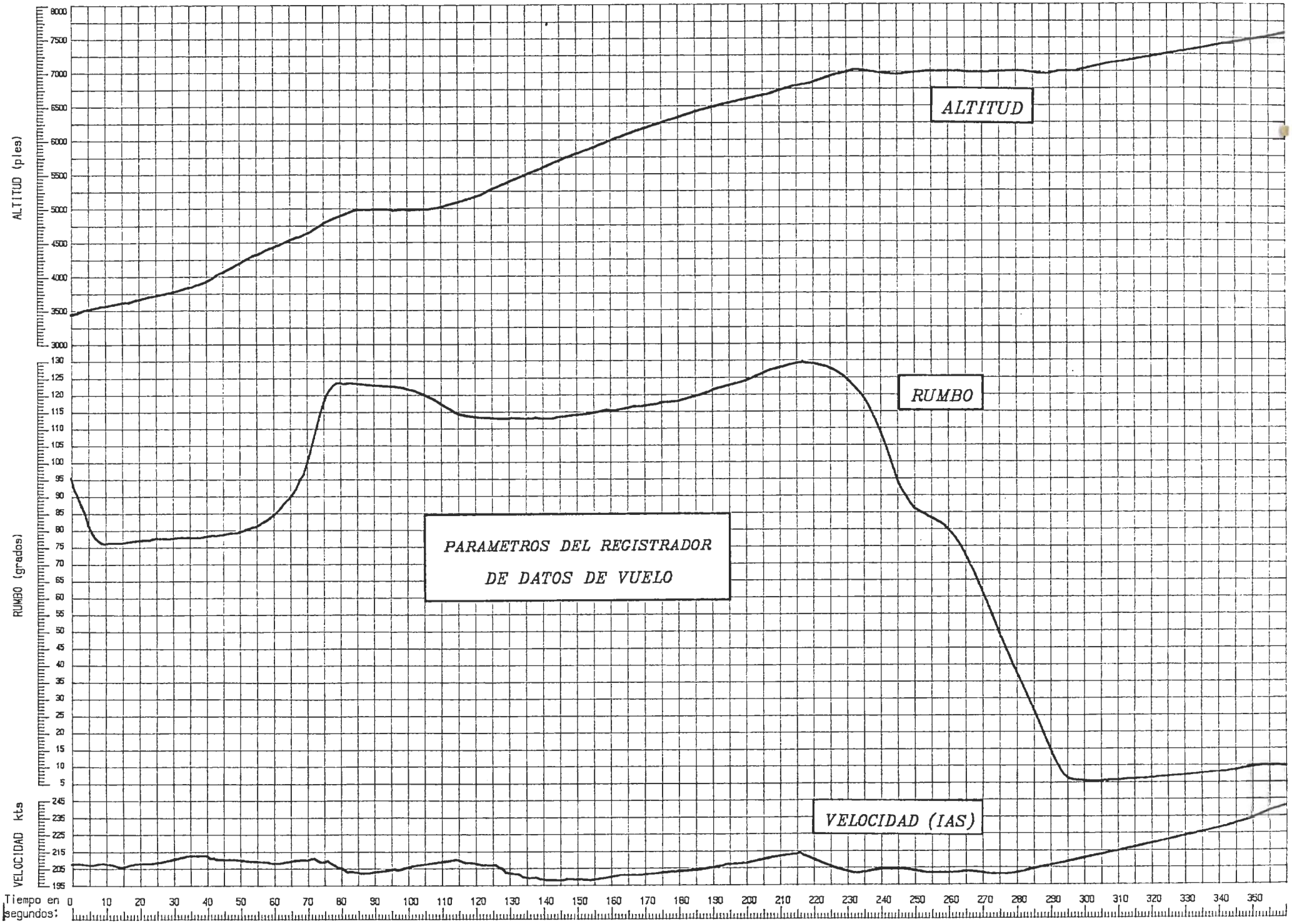
Directo al NDB "BLO", viraje a la derecha en rumbo 340°. ASC 5000'(4879'), viraje reglamentario a la derecha y regresar a INT R-121/13,0 VOR/DME "BLV" vía NDB "BLO".

Veloc. APCH (Kts)	110	120	130	140	150	160	170	180	190	200
Descenso en Ft/m	652	711	771	830	889	948	1008	1067	1126	1186
OM a RWY = 3,98 NM	2:10	1:59	1:50	1:42	1:36	1:30	1:24	1:20	1:15	1:12

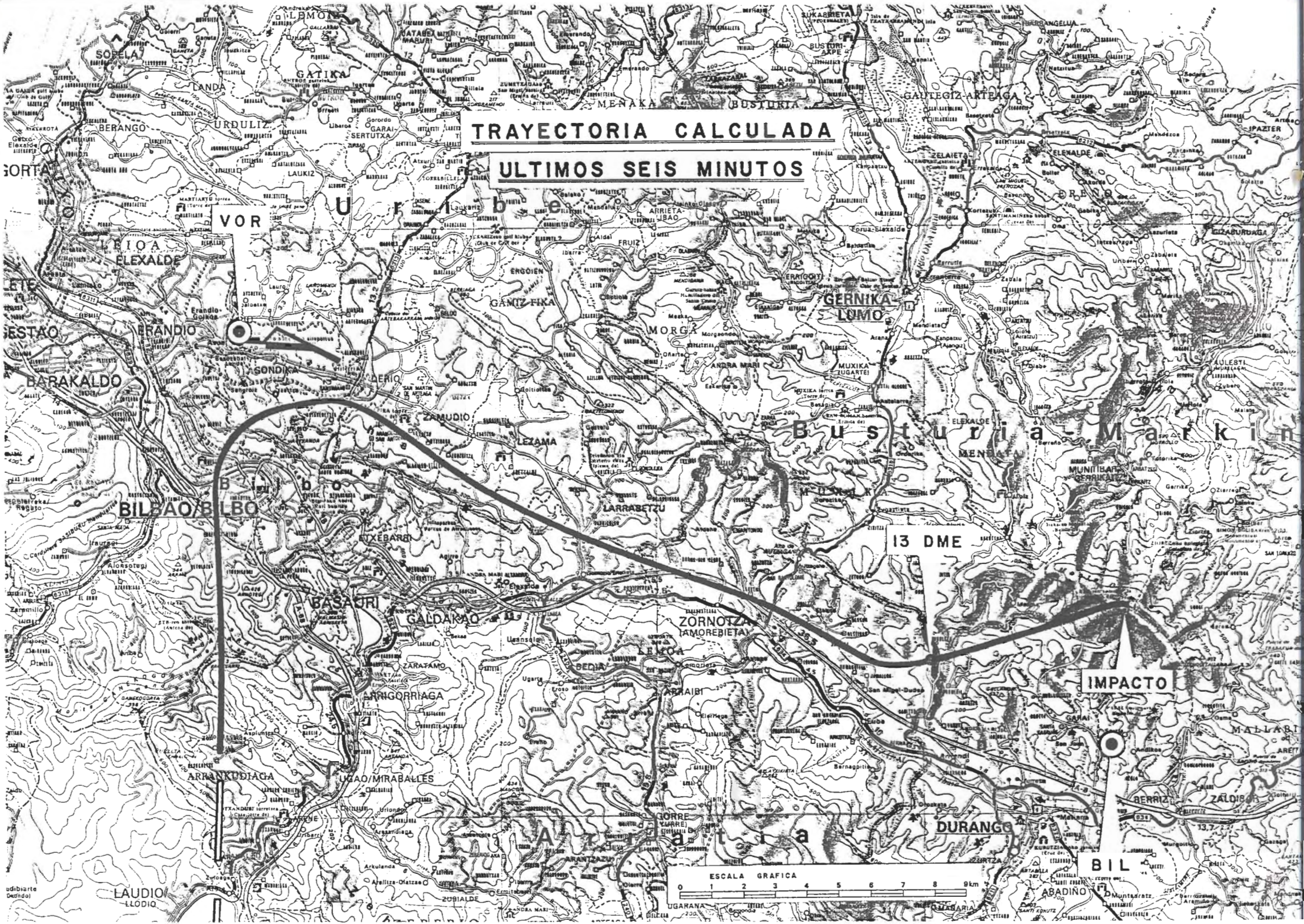
17-JUL-84 bilbao

CAMBIOS: REV.

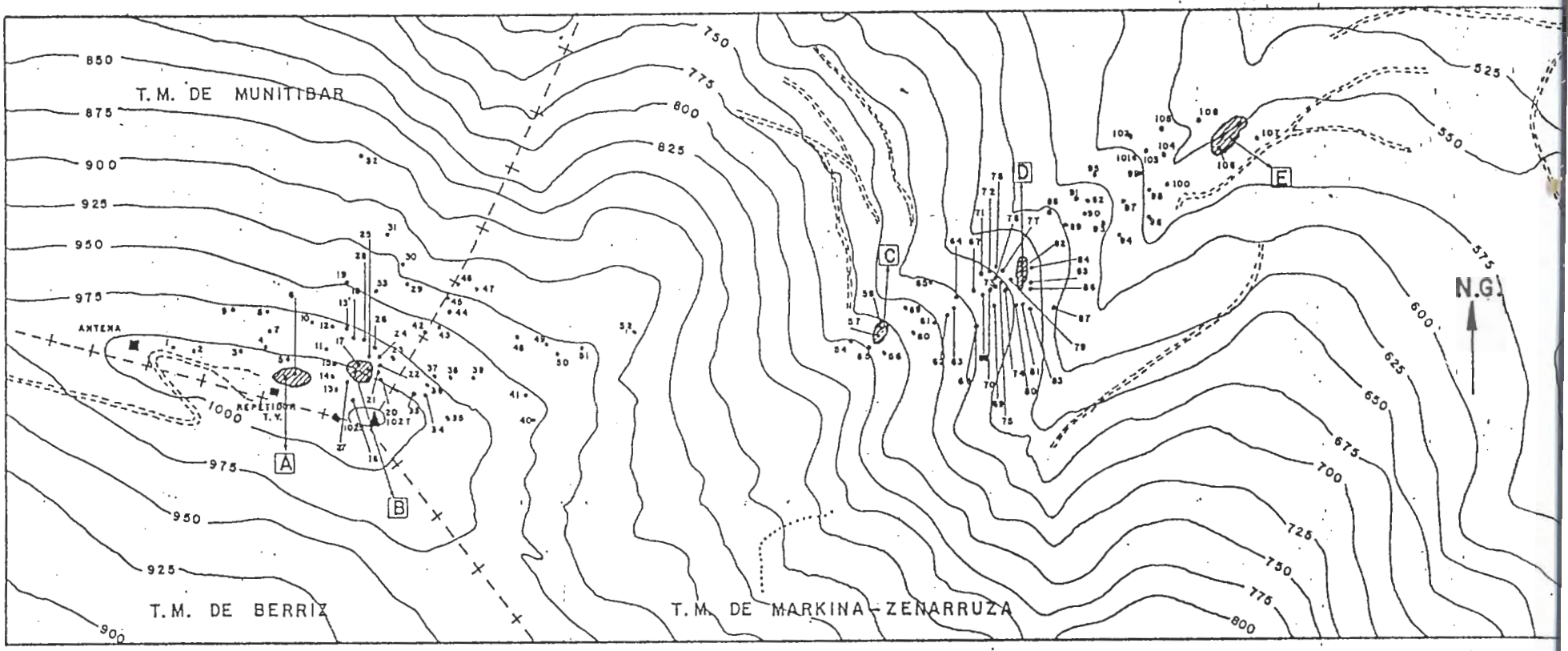
A N E X O : C


ALTITUD (pies)
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
ALTITUD
RUMBO (grados)
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
RUMBO
PARAMETROS DEL REGISTRADOR
DE DATOS DE VUELO
VELOCIDAD kts
245
235
225
215
205
195
VELOCIDAD (IAS)
Tiempo en segundos:
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350

A N E X O : D


TRAYECTORIA CALCULADA
ULTIMOS SEIS MINUTOS
VOR
13 DME
IMPACTO
BIL
ESCALA GRAFICA
0 1 2 3 4 5 6 7 8 9km
Uribe
Bilbao
Bizkaia-Markina
Arratia
SOPELA
LEMOA
GATIKA
LANDA
URDULIZ
BERANGO
MENAKA
BUSTURIA
GAUTEGIZ-ARTEAGA
IPAZTER
ELEXALDE
ERENO
GIZABURUAGA
LEIOA
ERANDIO
BARAKALDO
ASONDIKA
ZAMUDIO
LEZAMA
GAMIZ-FIKA
MORGA
GERNIKA LUMO
MUXIKA (UGARTE)
ANDRA MARI
MUNITIBAR-ARBATZEGI GERRIKAITZ
BILBAO/BILBO
LARRABETZU
BASAURI
GALDAKAO
ZORNOTZA (AMOREBIETA)
LEMOA
ZARATAMO
ARRIGORRIAGA
ARRAIBI
BEDIA
ARRANKUDIAGA
UGAO/MIRABALLES
DURANGO
BERRIZ
ZALDIBAR
MALLABI
LAUDIO/LLODIO
ZUBIALDE
ARANTZAZU
ABADIÑO
UGARANA
MASARA

A N E X O : E



CROQUIS DE SITUACION DE RESTOS (ESCALA APROXIMADA 1:5.000)

1.- REGISTRO MULTIPLICADOR DE FLUJO.
2.- REGISTRO ACCESO SEPARADOR DE AGUA.
3.- SEPARADOR DE AGUA.
4.- TUBO DE NEUMÁTICO.
5.- CARRIL DE BLAT CON RODAMIENTOS.
6.- RESTOS DE ALERON EXTERIOR IZQUIERDO.
7.- RESTOS UNION SECCIONES 45/48.
8.- COMPUERTA TREN DE MORRO IZQUIERDA.
9.- RESTO LLANTA IZQUIERDA TREN DE MORRO.
10.- MARTINETE BLAT.
11.- RESTOS ALERON EXT. ZONA EXTRADOS (P/N 65-21723-141.
12.- RESTO DE LLANTA.
13.- VENTILACION TANQUE COMBUSTIBLE.
14.- ACTUADOR TREN PRINCIPAL MECANISMO ACCIONAMIENTO TIERRA/VUELO VALVULA CONTROL SPOILER TRANSMISOR POSICIONES FLAPS.
15.- RESTO DE FLAP.
16.- TROZO DE TORRE DE LA ANTENA TV.
17.- CONJUNTO SOPORTE SPOILER DE TIERRA.
18.- RESTOS DE ALERON.
19.- EXTRADOS PLANO IZQ. ZONA ALOJAMIENTO TREN.
20.- HUSILLOS DE FLAP (2) Y RESTO DE LLANTA.
21.- RESTO DE "PORE FLAP".
22.- BARRA TORSION ACCIONAMIENTO FLAP.
23.- CARENA INT. DE FLAP Y APOYO SPOILER N°3.
24.- CARCASA "MONITOR COMPARATOR" Y RESTO CARRIL DE BLAT.
25.- CARRIL DE BLAT.
26.- COMPUERTA SCOUIDORA TREN IZQ. Y SPOILER CON SU ACTUADOR.
27.- PANEL DE BALANCEO DEL ALERON EXTERIOR.
28.- ALERON IZQUIERDO INTERIOR.
29.- RECUBRIMIENTO TANQUE COMBUSTIBLE.
30.- REGISTRO ACCESO TRANSMISORES DE FLAP.
31.- RESTOS DE FLAP.
32.- RESTOS DE CUBIERTA TREN PRINCIPAL.
33.- RESTO FLAP BORDE DE SALIDA DE ALA.
34.- COSTILLA TANQUE COMBUSTIBLE.
35.- RECUBRIMIENTO PARTE INT. DEL DEPOSITO COMBT.
36.- TROZO DE ANTENA DE LA TORRE.
37.- "PORE FLAP".
38.- CARRETON DE FLAP.
39.- FLAP EXTERIOR IZQUIERDO.
40.- PANEL DE BALANCEO DEL ALERON EXT. (P/N 65-21 728-13.
41.- RESTO DE ALERON CON COMPENSADOR.
42.- REFRIGERADO FAN DE AIRE ACONDICIONADO.
43.- TRANS. DE FLAP BORDE DE SALIDA DE ALA CON TROZO DE FALSO LARGUERO CON APOYO SPOILER.
44.- VIGA DE TREN IZQUIERDO.
45.- GIROSCOPO VERTICAL.
46.- RESTO LARGUERO ANTERIOR IZQ. CON VOLUMETRICA.
47.- TREN PRINCIPAL IZQUIERDO.
48.- "HARDING BEAM" IZQUIERDO.
49.- MECANISMO BLOCAJE TREN ARRIBA.
50.- CARENA DE CARRETON DE FLAP.
51.- FLAP DE BORDE DE ATAQUE N° 1.
52.- PLANO IZQUIERDO.
53.- PARTE DE ANTENA Y SPOILER TIERRA N° 1.
54.- PUNTA PLANO DERCH., "FLUX VALVE" DERCH., BOCA DE CARGA COMBUST., ANTERIOR A ESTOS RESTOS SE APRECIA PROXIMO A LA BASE DE UN ARBOL HUELLAS PRESUMIBLEMENTE DEL BORDE DE ATAQUE ESTABILIZADOR.
55.- LIMPIAPARABRISAS INCRUSTADO EN EL SUELO.
56.- RESTOS DE ESTABILIZADOR HORIZONTAL.
57.- SURCO O HUELLA PROFUNDA.
58.- HUSILLO DE FLAP.
59.- HUSILLO DE FLAP.
60.- CONTENIDO DE LA ZONA DE RESTOS DE VENTANILLAS DEL FUSELAJE.
61.- RESTOS DE BORDE DE SALIDA DE SUPERFICIE DE MANDO.
62.- CARRETON DE FLAP.
63.- ANILLO DE CARTER.
64.- ACTUADOR DE SPOILER.
65.- BLAT N° 5.
66.- RESTO HUSILLO DEL ESTABILIZADOR.
67.- CARENA CARRETON DE FLAP.
68.- PARTE INFERIOR PLANO CENTRAL.
69.- RECUBRIMIENTO FUSELAJE COLOCADO EN LA COPA DE UN ARBOL.
70.- BORDE SALIDA DE FLAP.
71.- RESTO DE FUSELAJE CON EL NOMBRE DEL AVION (ALMANDRA DE GUANDAJUCADO IZQUIERDO.
72.- ZONA INFERIOR FUSELAJE ZONA ADYACENTE A LA ENTRADA DEL COMPARTIMENTO E/E POSTERIOR.
73.- RESTOS DE PLANO.
74.- CUÑA FLAP BORDE DE SALIDA.
75.- RESTOS DE FUSELAJE PARTE TRASERA.
76.- BORDE MARGINAL DEL ESTABILIZADOR VERTICAL.
77.- BORDE DE SALIDA DE FLAP.
78.- ESTRUCTURA INF. COMPARTIMENTO E/E.
79.- RESTOS DE PLANO Y CUBIERTA DEL TREN DE MORRO.
80.- CAJA DE Y.H.F.
81.- PRORE FLAP", GAFAS DE HUMO Y REGISTRO DE COMBUSTIBLE.
82.- RESTOS ENSERES CABINA TRIPULACION (CINTURON TRIPULACION, CARTERA VUELO, PARTES DE VUELO, UNIFORME AZAFATA, BUTACA TRIPULACION, ETC.).
83.- RESTO DE HUSILLO ESTABILIZADOR.
84.- CAJA DE ENGRANAJE DE HUSILLO DEL ESTABILIZADOR.
85.- COMPUTADOR SENSACION ARTIFICIAL DEL TIMON DE PROFUNDIDAD.
86.- ESTRUCTURA ESTABILIZADOR VERTICAL.
87.- GENERADOR DE MOTOR.
88.- PUERTA COMPARTIMENTO E/E ANTERIOR Y RESTO CARTERA DE TRIPULACION.
89.- RESTOS MODULO AIR-SPEED N° 2.
90.- RESTOS CHASIS C.A.D.C., RESTOS DE PARTES DE VUELO.
91.- RESTOS INDICADOR RCMI.
92.- TREN DE MORRO Y RESTOS DOCUMENTACION REGISTROS DE VUELO.
93.- RESTOS DE TACOMETRO Y CAPOT MOTOR N°1.
94.- MOTOR LIMPIAPARABRISAS, DOCUMENTACION PERSONAL.
95.- RESTOS FUSELAJE DE LA ESTRUCTURA BODEGA DELANTERA.
96.- GENERADOR.
97.- RESTOS DE TIMON DE DIRECCION, RESTOS CAJAS DE ACCESORIOS Y CARTERES MOTOR N° 1.
98.- RESTOS DOCUMENTACION CABINA TRIPULAC. JUNTO CON RESTOS DE DIAL DE COMPENSACION.
99.- GIROSCOPO DIRECCIONAL, ANEMOMETRO, CAZO DE CAFE.
100.- TRANSMISION DE FLAP, INDICADOR DE MATRICULA EN PANEL DEL MECANICO DE VUELO.
101.- PEDAL DE DIRECCION Y RESTOS DOCUMENTACION PERSONAL DE LA TRIPULACION.
102.- GIROSCOPO DIRECCIONAL, ACCESORIOS A.D.F., RADIO-ALTIMETRO.
103.- TRANSPONDER
104.- PALANCA DE TREN, MANUAL DE VUELO.
105.- HORIZONTE ARTIFICIAL.
106.- ESTRUCTURA DE COLA, F.D.R. Y C.V.R., CON "PITONES", MOTOR N°3, EN EL DESNIVEL ANTERIOR SE ENCUENTRAN RESTOS DEL MOTOR N°1.
107.- MOTOR N° 2.
108.- PATA DERECHA DE TREN PRINCIPAL.

"A" - ZONA IMPACTADA
"B" - ZONA QUEMADA
"C" - SURCO PROFUNDO
"D" - ZONA RESTOS DE CABINA
"E" - ZONA DE RESTOS FINALES DEL AVION