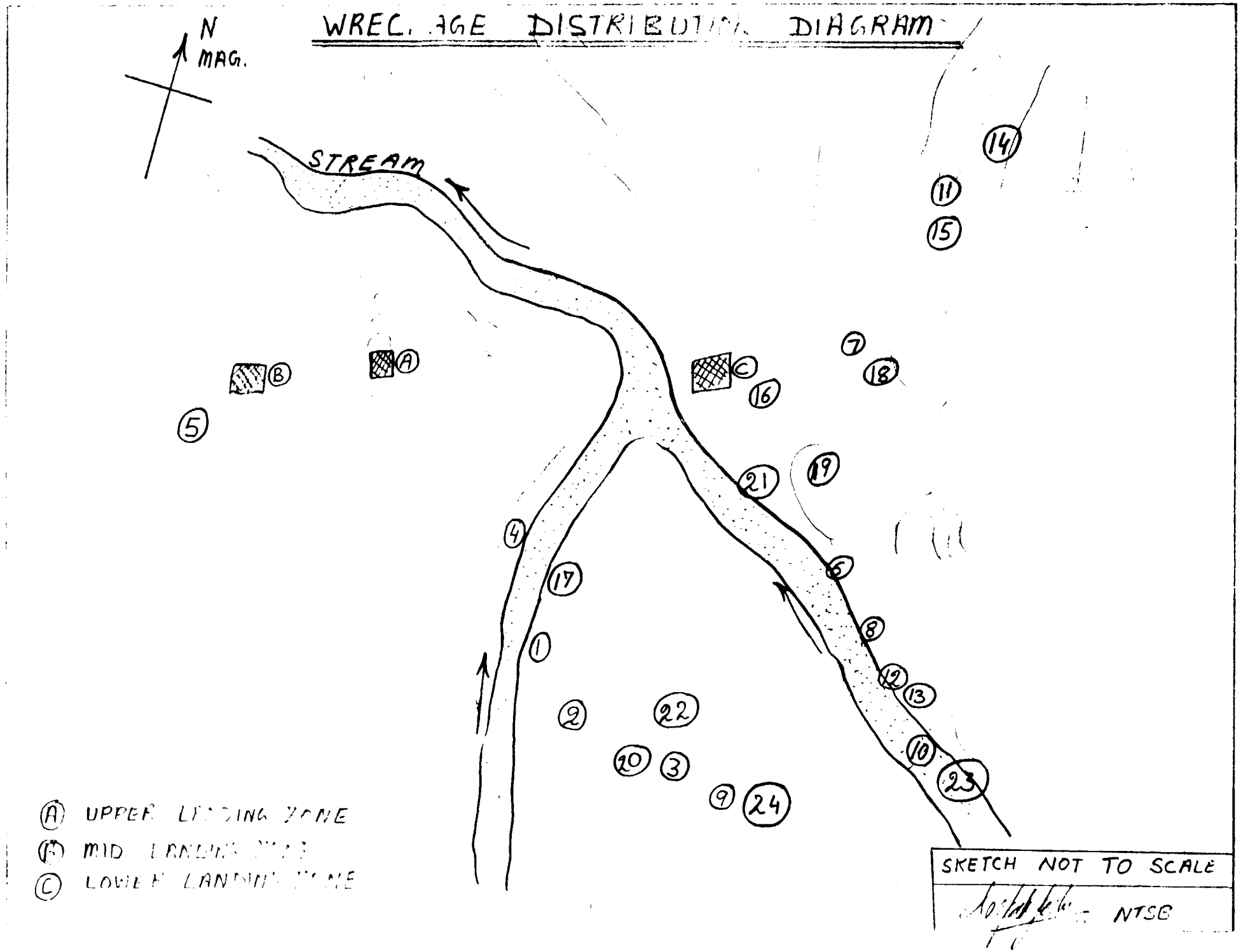
APÉNDICE B

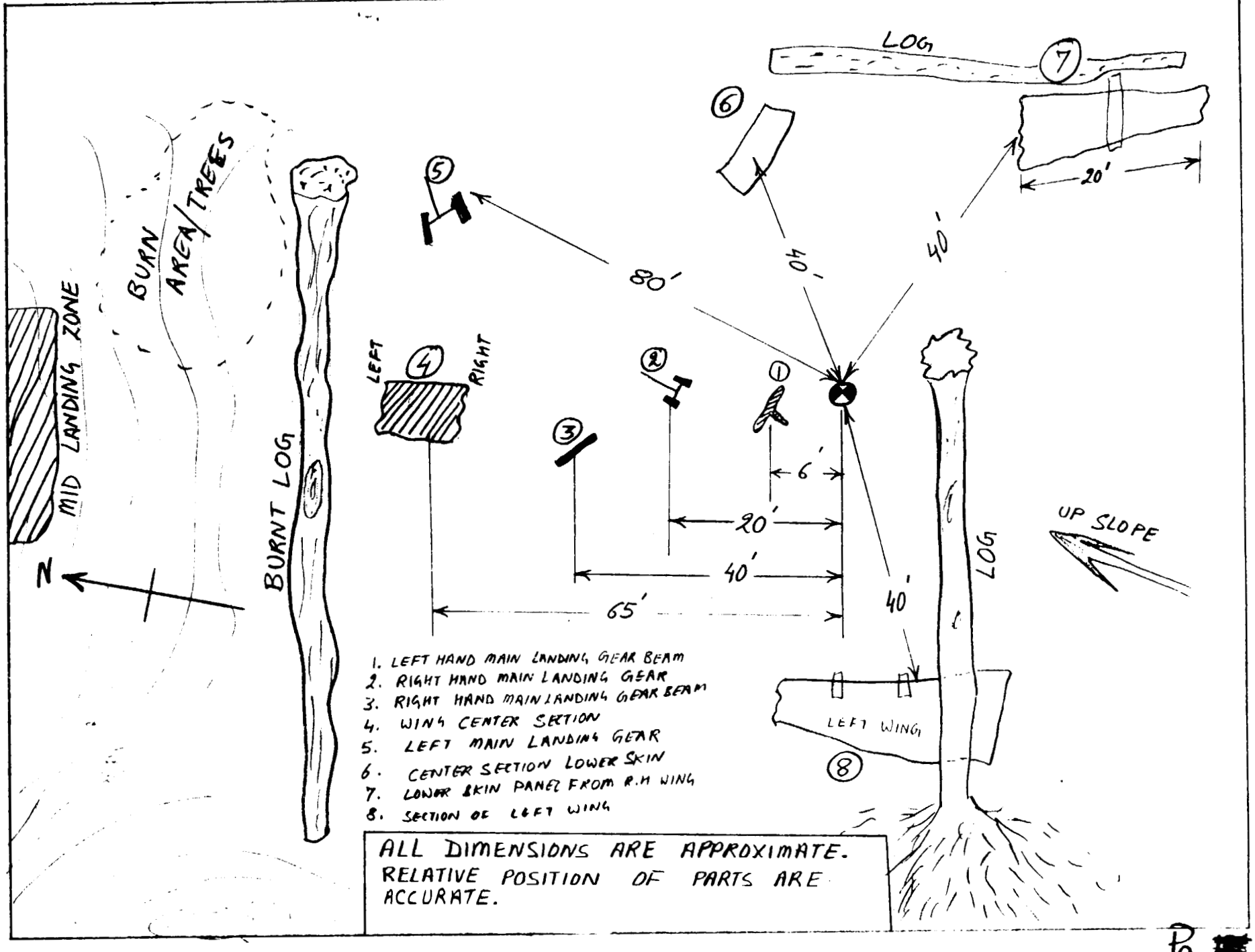
HOJA DE CUBIERTA

INFORMACIÓN DEL SITIO DEL ACCIDENTE


WREC. AGE DISTRIBUTION DIAGRAM
N
MAG.
STREAM
14
11
15
7
18
16
5
21
19
4
17
6
8
1
12
13
2
22
10
20
3
23
9
24
(A) UPPER LANDING ZONE
(B) MID LANDING ZONE
(C) LOWER LANDING ZONE
SKETCH NOT TO SCALE
NTSB

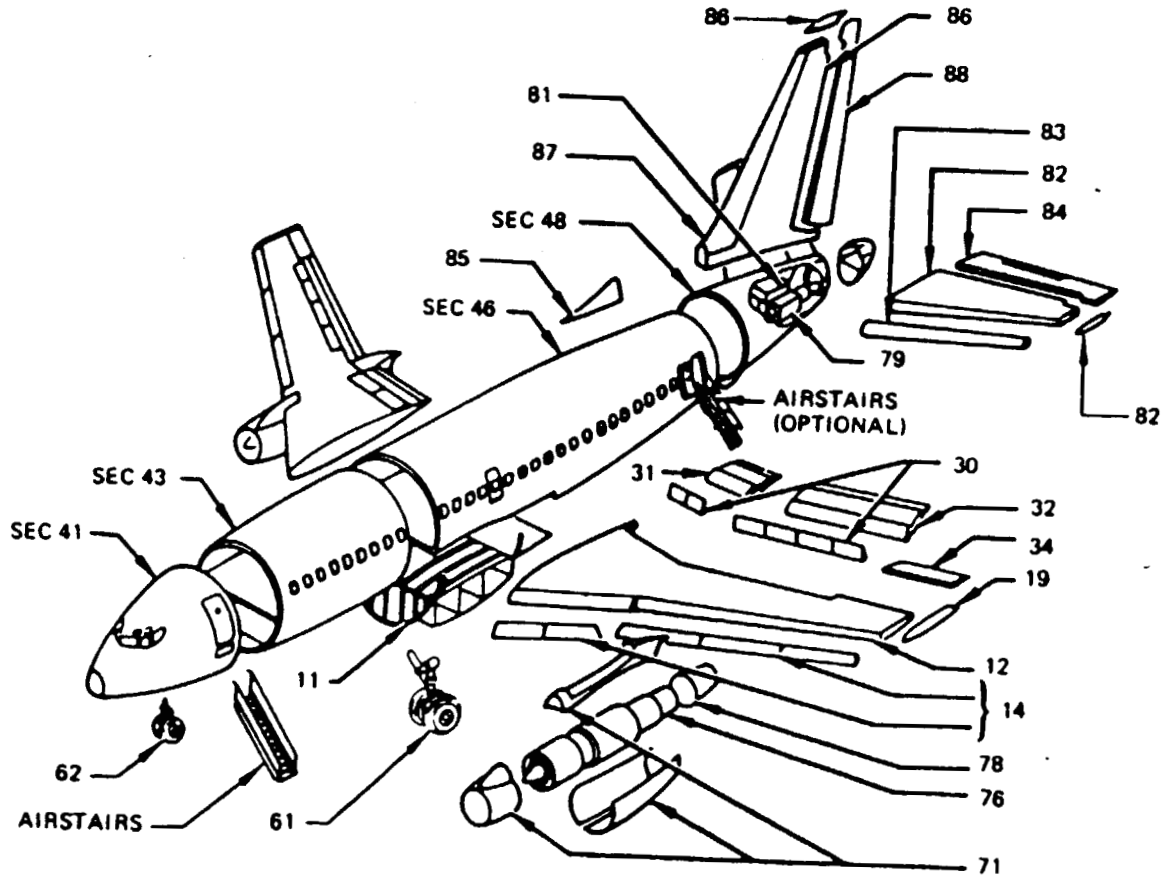
INDEX

MAIN WRECKAGE — WING CENTER SECTION



Pg.

AIRPLANE SECTION NUMBERS



APÉNDICE C

HOJA DE CUBIERTA

DIFERENCIAS DE CONFIGURACIÓN DE FLOTA EN LA TRANSFERENCIA DE ACTITUD (Vertical Gyro) DEL COPA 737

Boeing Commercial Airplane Group
P.O. Box 3707
Seattle, WA 98124-2207

May 25, 1994
B-U01B-14779-ASI

Mr. Greg Phillips, AS-40
National Transportation Safety Board
490 L'Enfant Plaza, S. W.
Washington D.C. 20594-2000

BOEING

Subject: COPA 737 Attitude (Vertical Gyro) Transfer Configuration Differences, 737-200 Accident Near Tucuti, Panama, June 6, 1992

Reference: Telecon G. Phillips with D. Rodrigues, May 10, 1994

Dear Mr. Phillips:

During the reference telecon, you requested that Boeing provide information regarding the differences in Vertical Gyro switching configurations on the COPA 737 fleet. This information was requested to try to better understand the selection of the VG switch position found in the subject accident.

In response to your request, we are enclosing with this letter the configuration differences for Vertical Gyro switches that were on the various COPA 737 airplanes. The airplanes listed include all 737 airplanes that were owned or leased by COPA. The enclosed shows the dates that COPA operated the airplanes and the panel configuration of each airplane. Also included is the configuration of the simulator at Piedmont where we understand the flight crew of the subject accident airplane received training. The enclosed information shows various configurations in the COPA fleet, including two airplanes and simulator trainer with an auxiliary VG system.

If you have any further questions, please do not hesitate to contact me at any time.

Very truly yours,

FLIGHT TEST

[redacted]

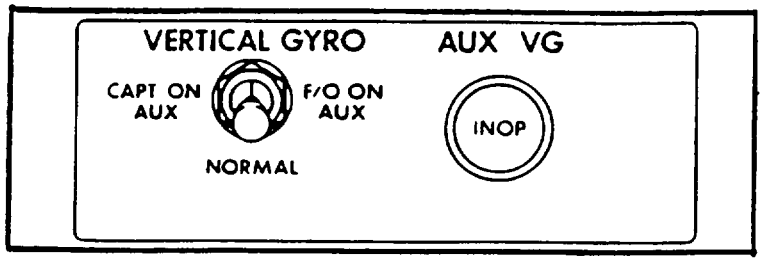
John W. Purvis
Director, Air Safety Investigation
Orgn. B-U01B, Mail Stop 14-HM
Telex 32-9430, STA DIR PURVIS
[redacted]
Datafax (206) 655-8533

Enclosure: As noted - 3 pages

BETWEEN DECEMBER 1980 AND JUNE 1992, COPA OPERATED 8 DIFFERENT 737 AIRPLANES WITH 5 DIFFERENT ATTITUDE (VERTICAL GYRO) TRANSFER CONFIGURATIONS. THE FOLLOWING DESCRIBES EACH CONFIGURATION AND TIME REFERENCE.

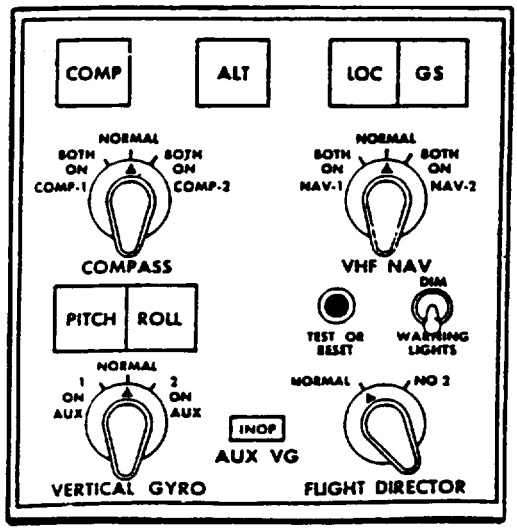
AIRCRAFT PC001 (EX-SINGAPORE) DEC. 80 TO NOV. 92

AN AUXILIARY VERTICAL GYRO (VG) WAS INSTALLED, IN ADDITION TO VG NO. 1 AND VG NO. 2. A DEDICATED ATTITUDE (VG) TRANSFER SWITCH WAS LOCATED ON P9 FORWARD ELECTRONICS PANEL. A TOGGLE SWITCH (SIDE TO SIDE) ENABLED EITHER CAPTAIN (CAPT ON AUX) OR THE FIRST OFFICER (F/O ON AUX) TO SELECT AUX. VG.(BOTH COULD NOT CHOOSE AUX. VG AT THE SAME TIME.) WITH THE SWITCH IN 'NORMAL' POSITION, CAPT WAS ON VG NO. 1 AND F/O ON VG NO. 2.



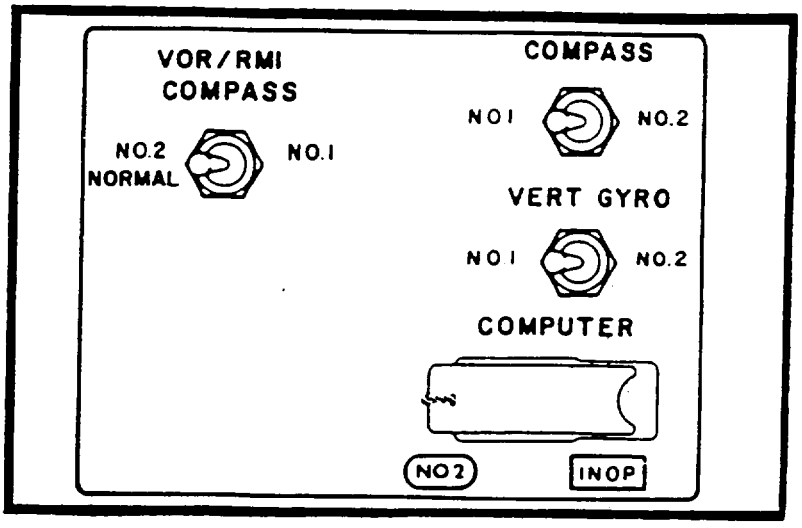
AIRCRAFT PG401 (EX-AIR NEW ZEALAND) OCT. 87 TO JAN. 88

AN AUXILIARY VERTICAL GYRO (VG) WAS INSTALLED IN ADDITION TO VG NO. 1 AND VG NO. 2. A VG TRANSFER SWITCH, A PART OF THE INSTRUMENT TRANSFER PANEL, WAS LOCATED AT P5 OVERHEAD PANEL. A ROTARY SWITCH ENABLED EITHER CAPTAIN (1 ON AUX) OR THE FIRST OFFICER (2 ON AUX) TO SELECT AUX. VG.(BOTH COULD NOT CHOOSE AUX. VG AT THE SAME TIME.) WITH THE SWITCH IN 'NORMAL' POSITION, CAPT WAS ON VG NO. 1 AND F/O ON VG NO. 2.



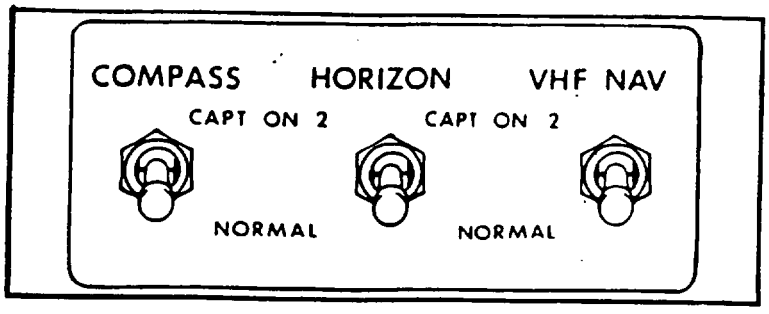
AIRCRAFT PY341 (EX-LUFTHANSA) JAN. 88 TO PRESENT

NO AUXILIARY VG WAS INSTALLED. A VG TRANSFER SWITCH, A PART OF THE INSTRUMENT TRANSFER PANEL, WAS LOCATED AT P1 CAPTAIN'S INSTRUMENT PANEL. A TOGGLE SWITCH (SIDE TO SIDE) ENABLED CAPTAIN TO SELECT EITHER VG NO. 1 OR VG NO. 2. NO VG TRANSFER CAPABILITY WAS PROVIDED FOR THE FIRST OFFICER.



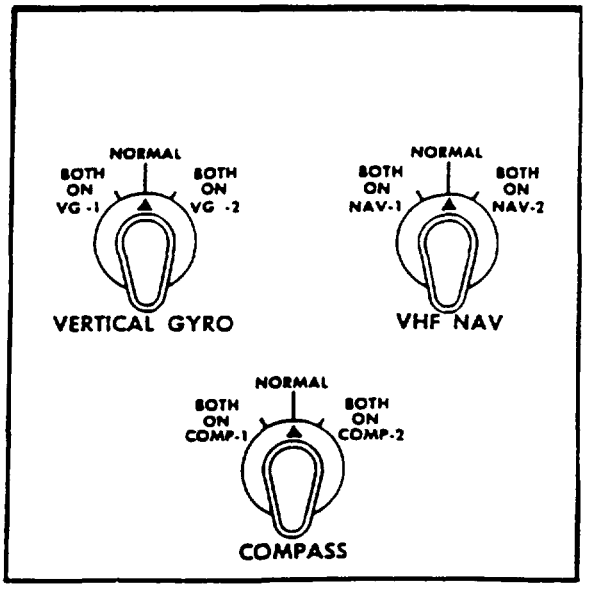
AIRCRAFT PG572 (EX-ALL NIPPON) JUL. 90 TO FEB. 91

NO AUXILIARY VG WAS INSTALLED. A VG TRANSFER SWITCH, A PART OF THE INSTRUMENT TRANSFER PANEL, WAS LOCATED AT P5 OVERHEAD PANEL. A TOGGLE SWITCH (UP-DOWN) ENABLED CAPTAIN TO SELECT EITHER VG NO. 1 (NORMAL) OR VG NO. 2 (CAPT ON 2). NO VG TRANSFER CAPABILITY WAS PROVIDED FOR THE FIRST OFFICER.



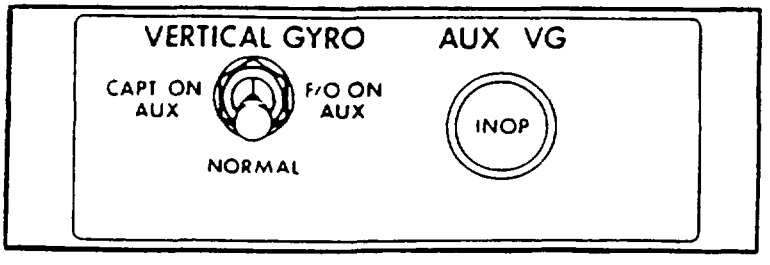
AIRCRAFT PJ112 (EX-BRITANNIA)	NOV. 89 TO PRESENT
AIRCRAFT PJ107	SEP. 91 TO PRESENT
AIRCRAFT PJ106	OCT. 91 TO DEC. 91
AIRCRAFT PJ116	APR. 92 TO JUNE 92

NO AUXILIARY VG WAS INSTALLED. A VG TRANSFER SWITCH, A PART OF THE INSTRUMENT TRANSFER PANEL, WAS LOCATED AT P5 OVERHEAD PANEL. A ROTARY SWITCH ENABLED CAPTAIN TO SELECT VG NO. 2 VIA F/O'S ADI (BOTH ON VG-2) OR F/O TO SELECT VG NO. 1 VIA CAPTAIN'S ADI (BOTH ON VG-1). WITH THE SWITCH IN 'NORMAL' POSITION, CAPT WAS ON VG NO. 1 AND F/O ON VG NO. 2.



WE UNDERSTAND THAT COPA FLIGHT CREW RECEIVED SIMULATOR TRAINING USING PIEDMONT FLIGHT SIMULATOR. PIEDMONT CONFIGURATION IS PROVIDED AS REFERENCE.

PIEDMONT 737-200
AN AUXILIARY VERTICAL GYRO (VG) WAS INSTALLED, IN ADDITION TO VG NO. 1 AND VG NO. 2. A DEDICATED ATTITUDE (VG) TRANSFER SWITCH WAS LOCATED ON P5 OVERHEAD PANEL. A TOGGLE SWITCH (SIDE TO SIDE) ENABLED EITHER CAPTAIN (CAPT ON AUX) OR THE FIRST OFFICER (F/O ON AUX) TO SELECT AUX. VG.(BOTH COULD NOT CHOOSE AUX. VG AT THE SAME TIME.) WITH THE SWITCH IN 'NORMAL' POSITION, CAPT WAS ON VG NO. 1 AND F/O ON VG NO. 2.



APÉNDICE D

HOJA DE CUBIERTA

ANÁLISIS DEL CANAL DEL TONEL DEL DFDR

Boeing Commercial Airplane Group
P.O. Box 3707
Seattle, WA 98124-2207

July 16, 1992
BU01B-13854-ASI

Mr. Tom Haueter
AS-10
National Transportation Safety Board
490 L'Enfant Plaza East SW
Washington D.C. 20594

Subject: DFDR Data on COPA 737 Aircraft HP-1205CMP, Accident Near Tucuti, Panama, June 6, 1992

BOEING

Reference: Meeting: NTSB, DAC, COPA, Boeing, June 15-17, 1992

Dear Mr. Haueter:

The following information is being provided in response to certain inquiries made by the NTSB and DAC in the reference meeting. Boeing has analyzed the roll channel information provided on the Flight Data Recorder (FDR). We have not investigated the possibility of whether a severe thunderstorm or some other weather related phenomena could have produced the aircraft bank angles depicted on the FDR roll channel. The discussion provided below is based on an assumption that the COPA 201 aircraft was not affected by any weather related phenomena.

The FDR information provided to Boeing by the NTSB, is plotted in Figure 1. The last 100 seconds of the flight are included on the plot. FDR time is noted on the bottom scale for reference.

An initial trim was conducted at the flight condition of the COPA 201 flight at FDR time 23:45, just prior to the final turn to a heading of 160°. The results of this trim are shown in Table 1.

TABLE 1

FDR TIME-MIN:SEC	ALT-FEET	VCAS-KCAS	ANGLE of ATTACK-DEG	STAB-DEG	WHEEL-DEG	RUDDER-DEG	HEADING RATE-DEG/SEC	BANK ANGLE-DEG
23:45	25009	322	2.44	3.41	0	0	0	0
24:28	25034	320	2.53	3.41	-4.5	0	-2.5	4.5
24:28	25034	320	2.84	3.41	41.5	5.98	-2.5	4.5
24:37	24959	323	2.72	3.41	-42.4	-5.89	0	-6.63
FDR TIME-MIN:SEC	EPR ENG1	EPR ENG2	CLIMB RATE-FT/MIN	SIDE ACCEL-FT/SEC^2				
23:45	1.746	1.746	0	0				
24:28	1.78	1.76	273	36.5				
24:28	1.78	1.76	-2864	33.0				
24:37	1.78	1.71	-582	0				

BOEING 1916 1991 75 YEARS

Very Important Attachment
Sharpness Test

Trims were also conducted at the flight condition of the COPA 201 aircraft at time 24:28, when the FDR was recording ~4° of bank angle. These trims were made both with the rudder set to zero and by trimming with the rudder. The results, shown in Table 1, supported earlier suspicions that the data recorded on the FDR roll channel may be erroneous. The yaw rate indicated by the FDR, at this time, is ~-2.5°/s. The side acceleration of the aircraft could not be trimmed out even with full rudder for this turn rate. If this much rudder were applied, the increase in drag due to the rudder and resulting sideslip would cause a descent rate much greater than that recorded on the FDR.

BOEING

During the period of time when the FDR was recording ~-36° of bank angle, a steady sideslip was simulated using full rudder. The bank angle which could be maintained with full rudder was only -6.6°. There is no way to hold heading nearly constant as the flight recorder shows with more than this bank angle assuming that the airplane configuration is normal. These data are shown in Table 1, at time 24:37.

Additionally, the simulator roll rate data in Figures 2 and 3 shows a much different profile than does the recorded FDR data. While the aircraft is capable of producing the level of roll rate recorded on the FDR, the roll acceleration that the aircraft is capable of producing is far less than that recorded on the FDR. In other words, the sharpness of the roll onset cannot be produced by aircraft control inputs. Also, the disturbance to the load factor shown in the plots of maximum wheel and rudder inputs are not evident in the FDR traces.

The remaining items on the list provided to the DAC and the NTSB during their visit will not be completed due to their assumption that the roll channel of the FDR was correct. We are continuing the investigation on the assumption that the roll channel is incorrect.

Very truly yours,

FLIGHT TEST

[redacted]

John W. Purvis
Director, Air Safety Investigation
Org B-U01B, Mail Stop 2M-99
Telex 32-9430, STA DIR PURVIS
[redacted]
Datafax (206) 544-8533

Enclosure: FDR Data Plots - 3 sheets

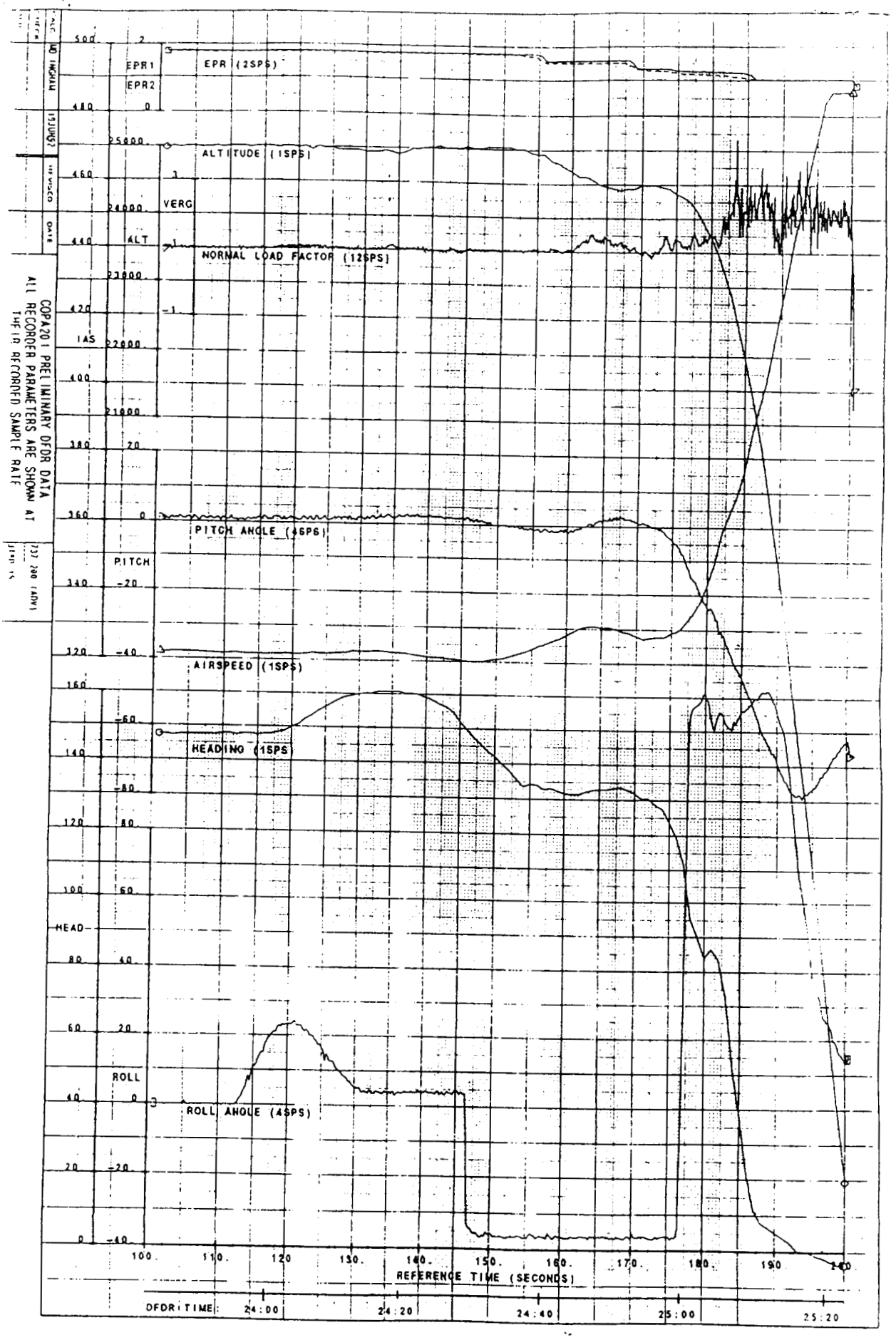

EPR (2SPS)
EPR1
EPR2
ALTITUDE (1SPS)
VERG
ALT
NORMAL LOAD FACTOR (12SPS)
IAS
PITCH ANGLE (4SPS)
PITCH
AIRSPEED (1SPS)
HEADING (1SPS)
HEAD
ROLL ANGLE (4SPS)
ROLL
REFERENCE TIME (SECONDS)
DFDR TIME
COPA201 PRELIMINARY DFDR DATA
ALL RECORDER PARAMETERS ARE SHOWN AT THEIR RECORDED SAMPLE RATE

FIGURE 1

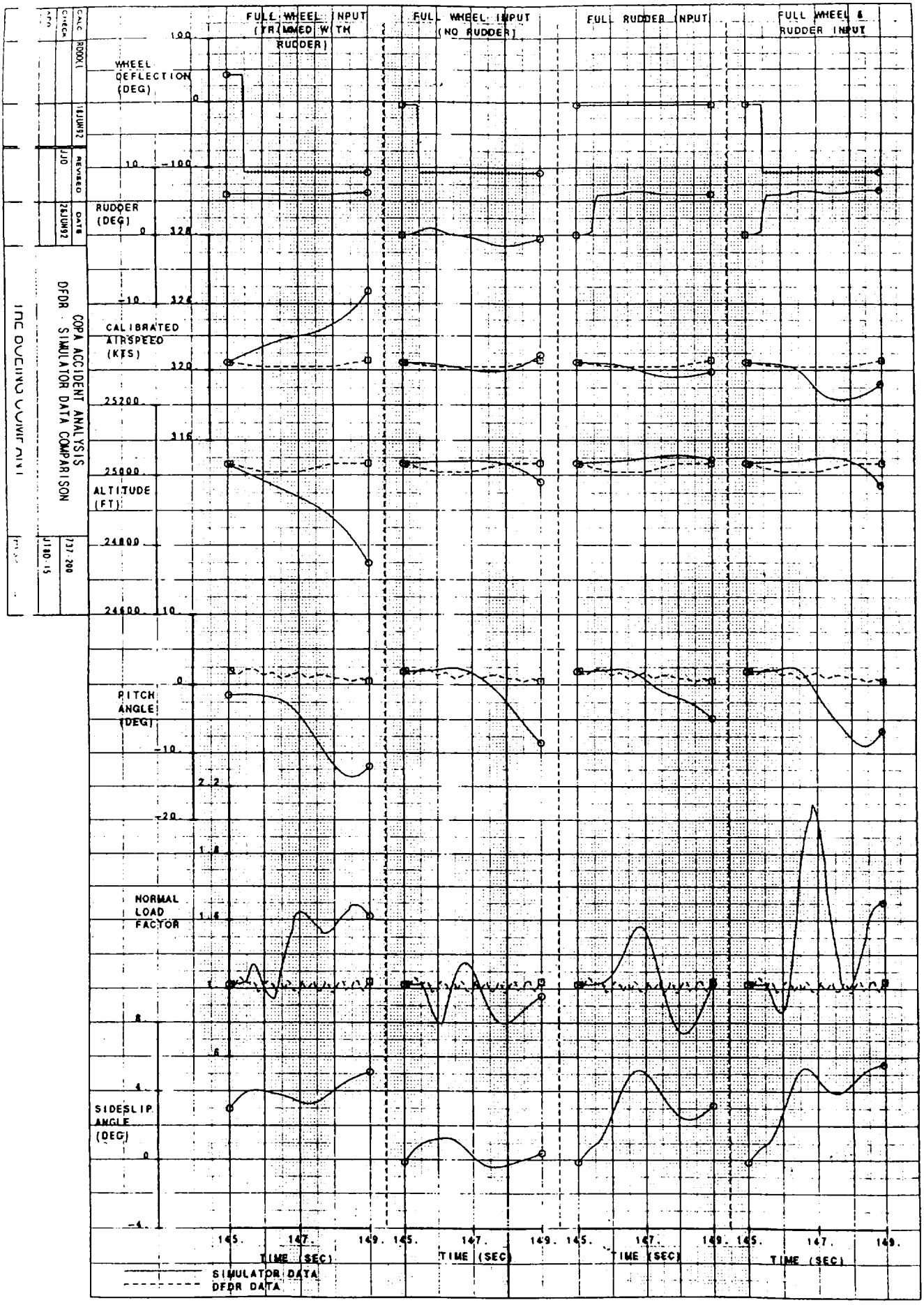

FULL WHEEL INPUT (TRIMMED WITH RUDDER)
FULL WHEEL INPUT (NO RUDDER)
FULL RUDDER INPUT
FULL WHEEL & RUDDER INPUT
WHEEL DEFLECTION (DEG)
RUDDER (DEG)
CALIBRATED AIRSPEED (KTS)
ALTITUDE (FT)
PITCH ANGLE (DEG)
NORMAL LOAD FACTOR
SIDESLIP ANGLE (DEG)
TIME (SEC)
SIMULATOR DATA
DFDR DATA
COPA ACCIDENT ANALYSIS
DFDR SIMULATOR DATA COMPARISON
THE BOEING COMPANY
737-200

FIGURE 2

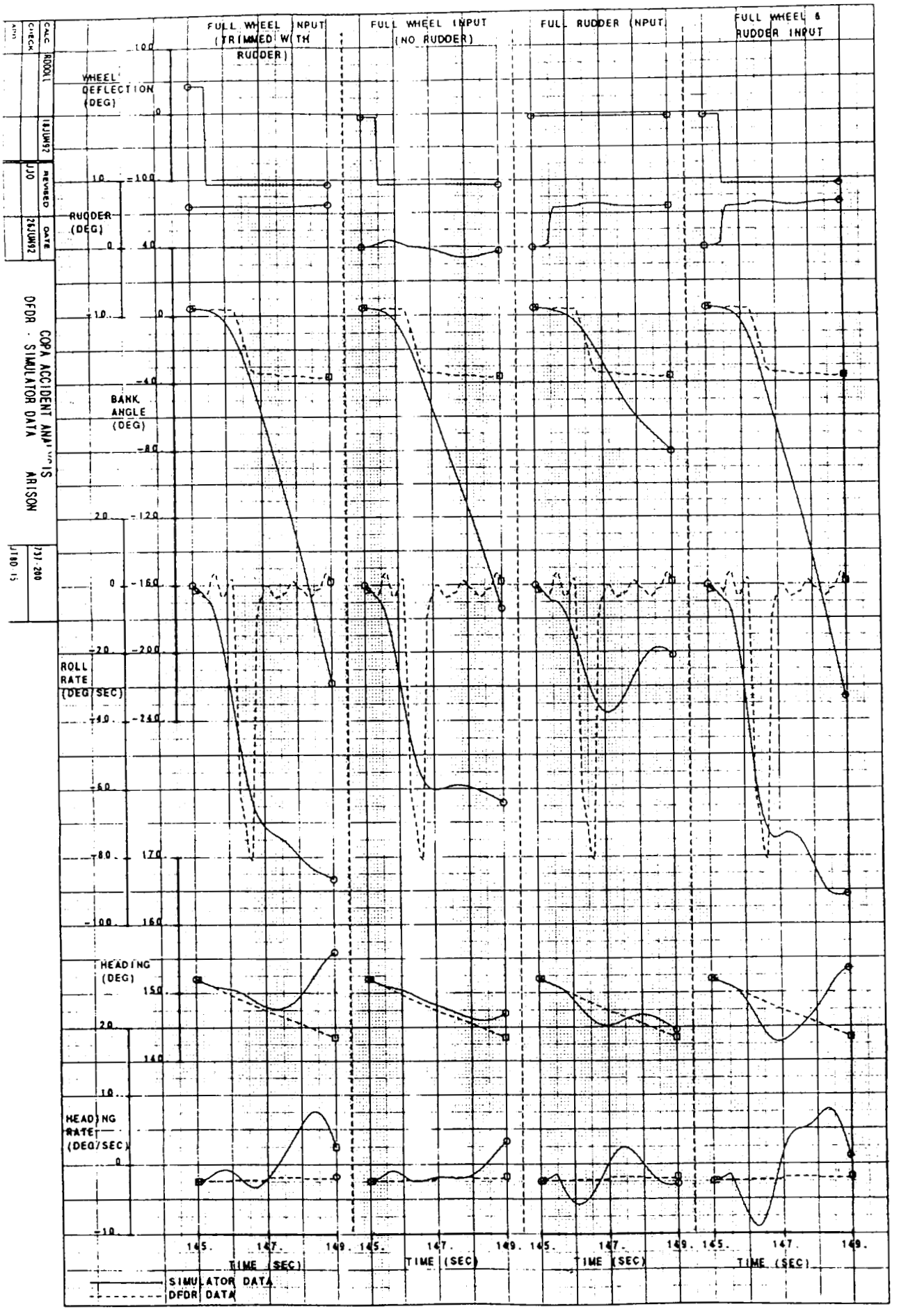

COPA ACCIDENT ANALYSIS
DFDR - SIMULATOR DATA
ARISON
737-200
CALC
CHECK
RDOOL
18JUN92
JJO
REVISED
DATE
26JUN92
FULL WHEEL INPUT (TRIMMED WITH RUDDER)
FULL WHEEL INPUT (NO RUDDER)
FULL RUDDER INPUT
FULL WHEEL & RUDDER INPUT
WHEEL DEFLECTION (DEG)
RUDDER (DEG)
BANK ANGLE (DEG)
ROLL RATE (DEG/SEC)
HEADING (DEG)
HEADING RATE (DEG/SEC)
TIME (SEC)
SIMULATOR DATA
DFDR DATA

FIGURE 3