

APÉNDICE E
HOJA DE CUBIERTA

ANÁLISIS DE DOS (2) GIRÓSCOPOS VERTICALES

Páginas 1 - 2	Carta de Honeywell Comm. Flight Safety Group, 16 de septiembte de 1992
Páginas 2 - 12	Notas de la Investigación

HONEYWELL

Commercial Flight Systems Group

P.O. Box 21111

Phoenix, AZ 85036-1111

28 September 1992

Boeing Commercial Airplanes

P.O. Box 3707

Seattle, WA 98124-2207

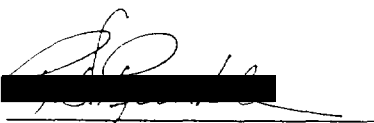
Attn: Ron Christianson, MS 2H-30

Dear sir:

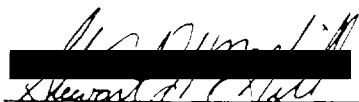
Attached you will find a copy of the crash analysis performed on the units returned to us from the COPA 737 crash in Panama. This included two VG-312 Vertical Gyroscopes, two C-9D Directional Gyroscopes, and two C-6E Compass Indicators. Also enclosed for your use are some additional copies of the photographs taken during the analysis and used in the report.

If we can be of any further help, please let us know.

Respectfully,



Ray Runkle
Gyro Products



Stewart McGill
Indicators

\rdr

enclosure

cc: Pam Kalish, Prod. Support

ACCOUNT NO.

SUBJECT COPA CRASH INVESTIGATION NAME STEWART MCGILL

DATE 2/SEPT 9

I. BACKGROUND INFORMATION



UNITED STATES OF AMERICA
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HONEYWELL PERSONNEL

- | | |
|-------------------|-----------------|
| 1) RAY RUNKLE | ENGINEER |
| 2) STEWART MCGILL | ENGINEER |
| 3) KEN GETTYS | SECT. HEAD ENG. |
| 4) PAUL KALISH | PRODUCT SUPPORT |
| 5) KEN PERKINS | ENG. TECH. |

II. COMPASS INDICATOR INFORMATION:

1.0 UNIT #1. (UNIT WAS FREE, NOT ATTACHED TO ANYTHING) CAPT. SIDE

TYPE: PN 1784460-655, CGE

SN : 78115420

MOD : H (ONLY BLACKEN)

OTHER: DATA PENED ON $\Rightarrow$ (737/265 REFE)

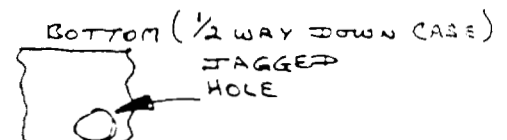
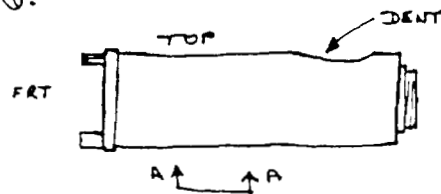
SEALS: FRONT (BEZEL TO CASE) ONLY BEZEL HALF PRESENT

REAR (COUPLING RING TO CASE) ONLY RING HALF PRESENT

SAFETY WIRE: RING AND LOCK SCREW - WIRED TOGETHER - NO LEAD SEAL.

REAR CONN. COND: PIN #14 AND #15 BENT OVER SLIGHTLY.

CASE COND.



IND. READOUT ETC. HDG CARD: 289°

#1 BEARING PTR: 182°

KNOB: VOR POSITION

#2 BEARING PTR: 158°

KNOB: ADF POSITION

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SPERRY AEROSPACE GROUP

3
DATE 21 SEPT 92



PART	SPERRY P/N	CONTINENTAL CONNECTOR CORP P/N
RECEPTACLE	739885-2*	1406-55 PQ
MATING PLUG	740017-2*	1406-55 SQ
HOOD (VARIABLE) STRAIGHT 90° (SHOWN)	740968-5 740022-5	1406-H 1406-H90

FIG. 1
TYPICAL C-6E INDICATOR

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SPERRY AEROSPACE GROUP

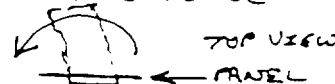
ACCOUNT NO.
SUBJECT COPA CRASH
INVESTIGATION

NAME STEWART MCGILL

DATE 9/22/92

2.0 UNIT #2 (UNIT IN PANEL, MOUNTED BELOW ASI) ^{F/O} SIDE
TYPE: PN1784460-655, C6-E
SN: 79075688
MOD: H (ONLY ONE BLACKEN)
OTHER: NOTHING NOTED
SEALS: FRONT SEAL (BEZEL TO CASE): ENTIRE SEAL INTACT
REAR SEAL (CASE TO COUPLING RING) ENTIRE SEAL INTACT
SAFETY WIRE: RING AND LOCK SCREW: WIRED TOGETHER - NO LEAD SEAL
REAR CONN: NO BENT PINS, OVERALL - GOOD SHAPE

IND. & CASE CONDITION: UNIT STILL MOUNTED IN A PARTIAL PANEL.
CASE SMASHED ON ~~TOP~~ ^{RIGHT} AND ON ~~RIGHT~~ ^{LEFT} (ALSO A HOLE IN THE ~~RIGHT~~ ^{LEFT}).
CASE IS PULLED AWAY FROM THE BEZEL. UNIT APPEARS TO BE
TORQUED TO THE LEFT AS VIEW FROM FRONT.



IND. READOUT AND KNOB POSITION: IND. FACE IS SMASHED.
THE BEZEL IS BROKEN AND PARTS OF IT ARE MISSING. ALL KNOBS
ARE MISSING. THE SLEW KNOB SHAFT IS SHEARED OFF AT THE
SHAFT PINNING HOLE (ALMOST FLUSH TO EDGE LIGHT PANEL). #2 BEARING
POINTER SELECTOR KNOB SHAFT IS BENT FLUSH AGAINST THE BEZEL
AT A 9 O'CLOCK POSITION. GENERAL AREA FOR #1 BEARING POINTER;
SELECTOR KNOB IS MISSING. BOTH BEARING POINTERS AND THE
POWER FAIL FLAG ARE MISSING.

HKG CARD: 306°

IND. OVERALL CONDITION: SEVERE INTERNAL DAMAGE EVIDENT. OBVIOUS
AS THE CASE IS BUSTED OPEN AND PEELED BACK FROM THE BEZEL. INTERNAL
COMPONENTS ARE LOOSE, BROKEN AWAY, AND OUT OF ALIGNMENT. GLASS AND
EDGE LIGHT PANEL MISSING. CORROSION FROM WATER DAMAGE.

REMOVED CASE: 3/4 OF UNIT REMAINED IN CASE. FRONT GEAR PLATE
BROKEN UP. HKG DIAL FROZEN AT 306°. UNIT NOT POWERED DUE TO
SEVERE DAMAGE.

NOTHING UNUSAL WAS NOTED INSIDE INDICATOR, OTHER THAN,
DAMAGE FROM ACCIDENT (IMPACT).

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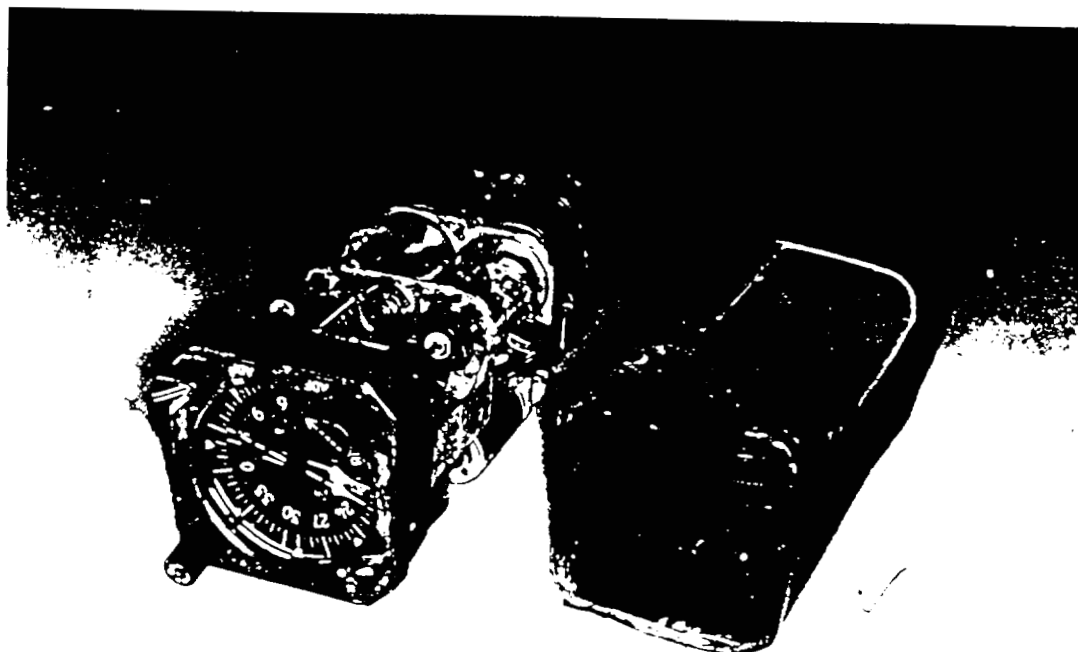
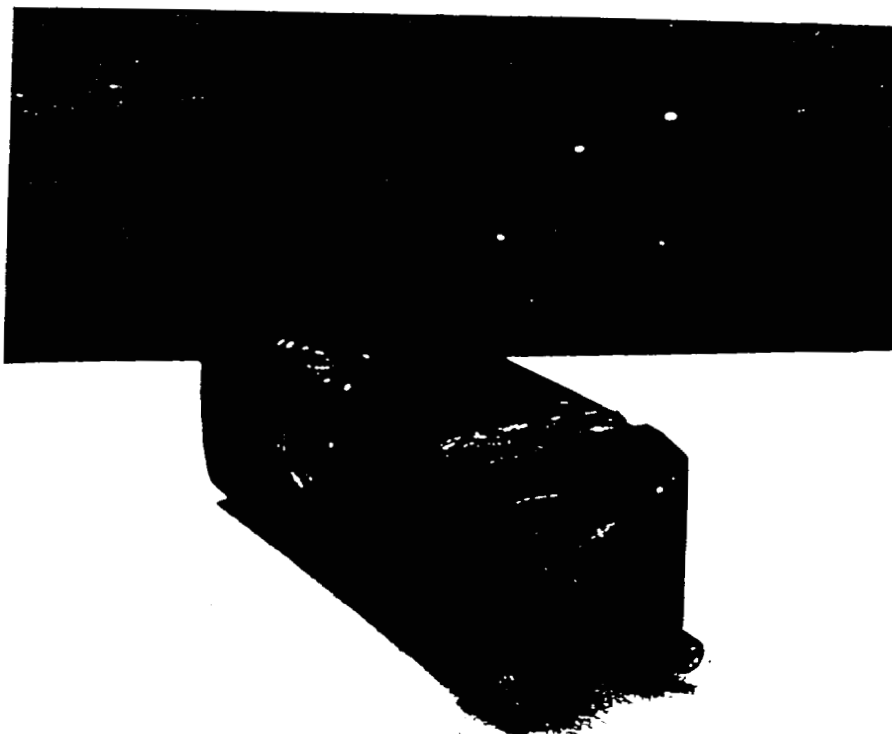
SPERRY AEROSPACE GROUP

ACCOUNT NO.
SUBJECT COPA CRASH
INVESTIGATION

NAME STEWART MCGILL

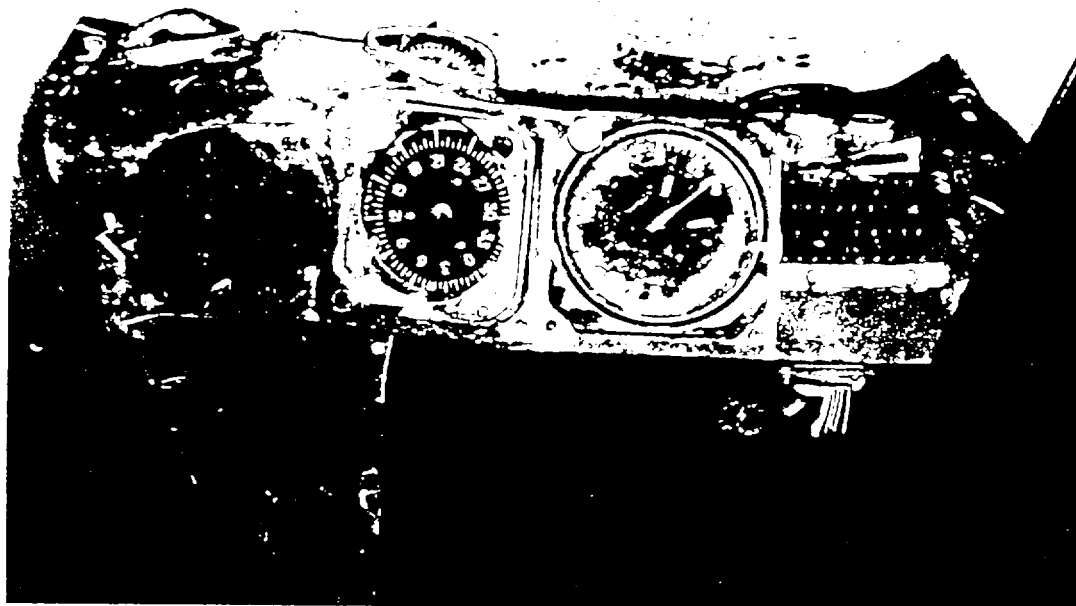
5
DATE 9/25/92

III. PHOTOGRAPHS
PICTURE (1) of 5
UNIT # 1



PICTURE (2)
UNIT #1

UNIT # 2
PICTURE (4)



UNIT # 2
PICTURE (3)



ACCOUNT NO.
SUBJECT CCRA CRASU
INVESTIGATION

NAME STEWART McGILL
DATE 9/25/92

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HONEYWELL INTERNATIONAL CORP.

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SPERRY AEROSPACE GROUP

ACCOUNT NO.
SUBJECT COPA CRASH
INVESTIGATION

NAME STEWART MCGILL

7
DATE 9/25/92



PICTURE (5) of 5
UNIT # 2

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ACCOUNT NO.
SUBJECT COPA CRASH
INVESTIGATION

NAME STEWART MCGILL

DATE 21 Sept 92

IND. READOUT CONDITION:

SLEW KNOB: DOT @ 12 O'CLOCK POSITION

X @ 9 O'CLOCK POSITION

KNOB BENT ABOUT 10 TO 15° TOWARD 1 O'CLOCK
POSITION (AS VIEWED HEAD-ON TO IND).

SLEW POINTER: POINTING @ DASH MARK

#1 PTR KNOB: APPEARS IN GOOD SHAPE - FUNCTIONS NORMALLY
MECHANICALLY.

#2 PTR KNOB: BENT DOWN TOWARD 6 O'CLOCK POSITION -
FUNCTIONS NORMALLY MECHANICALLY.

POWER FAIL FLAG: IN VIEW - LOOKS NORMAL

IND. OVERALL CONDITION: UNIT HAS SOMETHING LOOSE INSIDE. THE
IDENTIFICATION OF THE LOOSE PART WILL
NOT BE CLEAR UNTIL THE UNIT IS OPENED.

22 SEPT 1992

REMOVED UNIT CASE: PRIOR TO REMOVING THE CASE A 2 X 3 IN
SECTION WAS CUT OUT (DENTED PART OF CASE) TO FACILITATE
THE CASE REMOVAL. BRUSHES FOR TRANSFORMER B303 WERE
DEFORMED AND THE NYLON GEAR ON B303 WAS BROKEN. B307, DATA
TRANSMITTER, IS ALMOST BROKEN LOOSE FROM ITS MOUNTS. LOOSE ITEM
IN CASE WAS A BROKEN PIECE OF INTERNAL FRAME WORK (BROKEN FROM
IMPACT).

ELECTED NOT TO ATTEMPT POWERING UNIT DUE TO SEVERE DAMAGE.
NOTHING UNUSAL WAS NOTED INSIDE INDICATOR. POINTERS CAN
BE MOVED BY TAPPING ON IND. CASE. ALL DAMAGE APPEARS TO BE
FROM THE IMPACT.

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ACCOUNT NO.
SUBJECT

 **SPEERY**
FLIGHT SYSTEMS

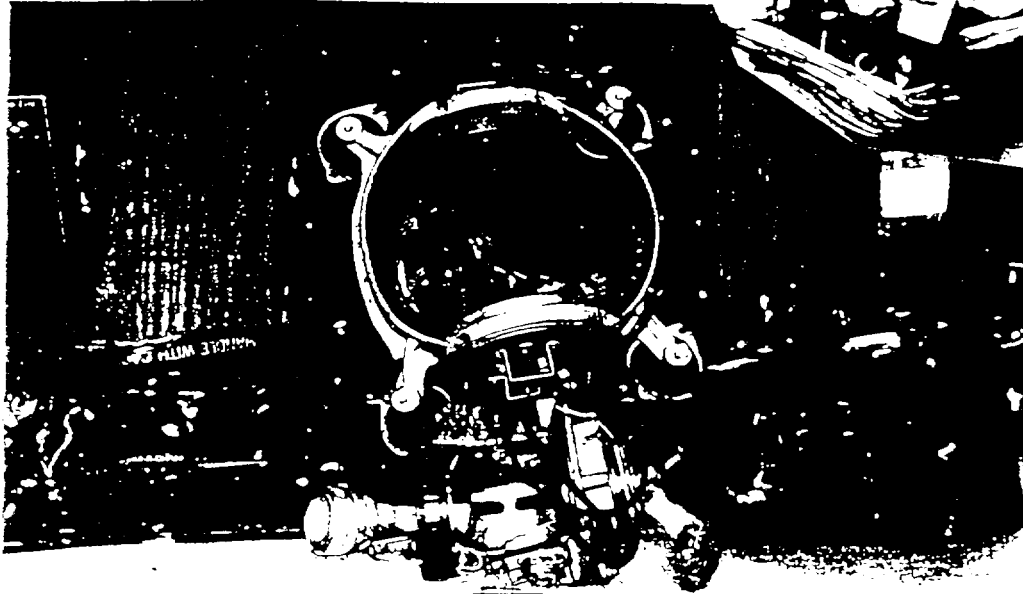
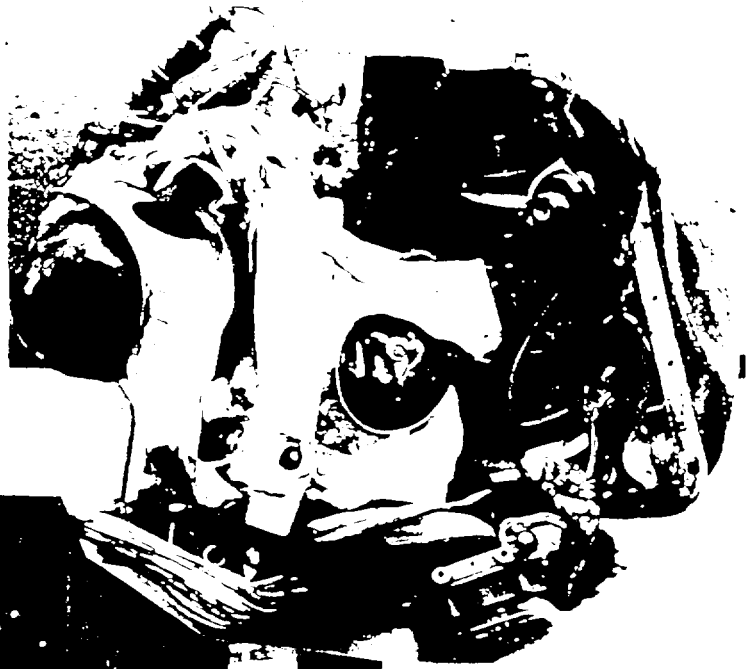
NAME

DATE

#2. As received

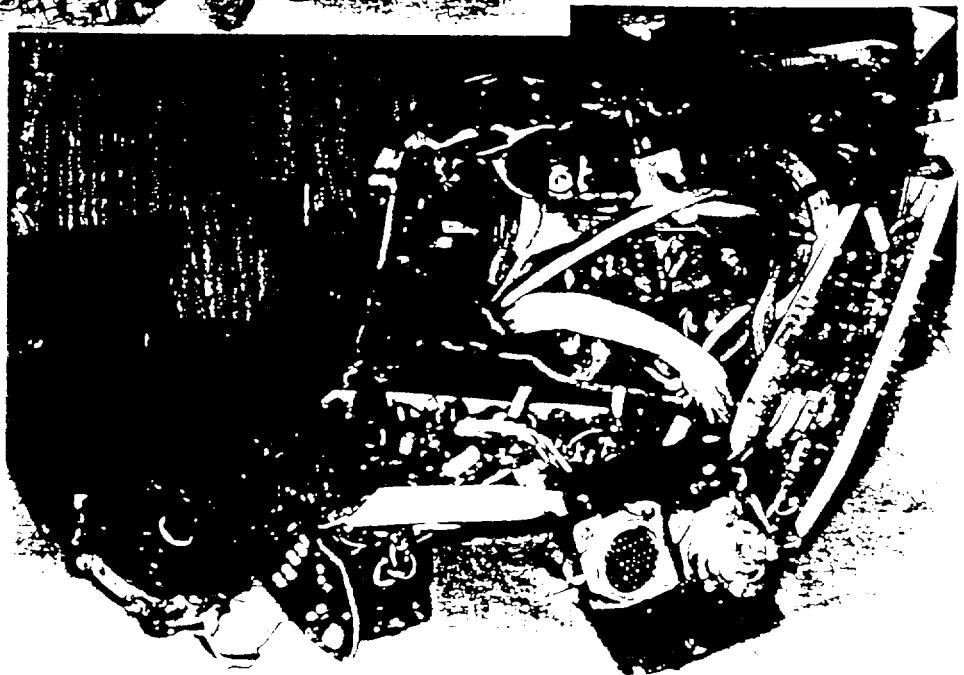


VG # 1174 received



#21. As received
Phys.

VG # 1174
Analysis →



ACCOUNT NO. 358412
SUBJECT COPA 737 CRASH INV.



135

NAME R. Runke

DATE 21 Sept 92

#2:

Photo: 2033 (Ging)

VG-312 2587335-12 S/N 79060686 MODS A-S U-X, Z-AC

Visual Inspection: Gyro is crushed from the top, 2 of 3 treaddown points are broken off. Base is crushed in from the bottom. The cover was removed. The outer gimbal frame was broken at all 4 corners. The gimbals are locked in a 20° pitch ~~down~~, 150° Right bank. The roll synchro is too badly damaged to power, ie wires broken. The pitch synchro may be OK. Extensive water damage. The rotor is heavily rusted. The gimbal assy. was removed from the housing. Both leveling lig. levels were smashed. Pitch synchro was excited and AFI indicated 43° pitch down. Both P.E.C.O. bottles were intact. Both R.E.C.O. bottles were smashed. The rotor assy. was disassembled and skid marks on the rotor and winding indicate the rotor was spinning when smashed. The bottom bearing was contaminated by water, the top brg. was good (lube, but Mobil 28. [should be Unitemp 500.]) The base has some smoke damage in the same areas, and same cap as below on 8013167. Connectors look good.
[See picture

#1:

VG-312 2587335-12 S/N 8013167 MODS A-Q, S, U, V, AA^{AB}, AC
Base S/N 07102235

Visual Inspection: Unit completely smashed. The rotor assy was broken away from roll gimbal frame. The pitch synchro was laying out loose, hanging from the output wires. It was powered up and indicated 23° nose down. The roll synchro was too badly damaged to power up. Repair tag shows last repaired 10-1-90 by Honeywell, S.R.R 38704 (last digit appears as 4). Rotor assembly was removed and opened: rotor assembly marks indicate rotor was spinning at impact, both ID & OD marks. Marks on the inside of the housing also indicate the rotor was spinning, but locked up rather quickly. Rotor bearings were lubed with improper grease. The outside of the rotor assy. was marked "LUBE G33." The bearing shield was Barden Mfg. Barden G33 grease is Mobil 28. [5/B Unitemp 500] The base was opened, had some smoke damage. C71 (Roll for. cont. field) was burned and heavily smoke damaged, along with surrounding area.

SEE REEXAMINATION, Sep 94

NOTE: Also reference notebook DX5635 (Stewart J. McGill) for analysis of the C-6 indicators involved in this crash.]

ACCOUNT NO. 352412
SUBJECT DG CRASH ANAL.

SPERRY
FLIGHT SYSTEMS

NAME R. Remke

137
DATE 22 Sept 92

DG #2 : DG-206A 2388302-4 S/N 3089003

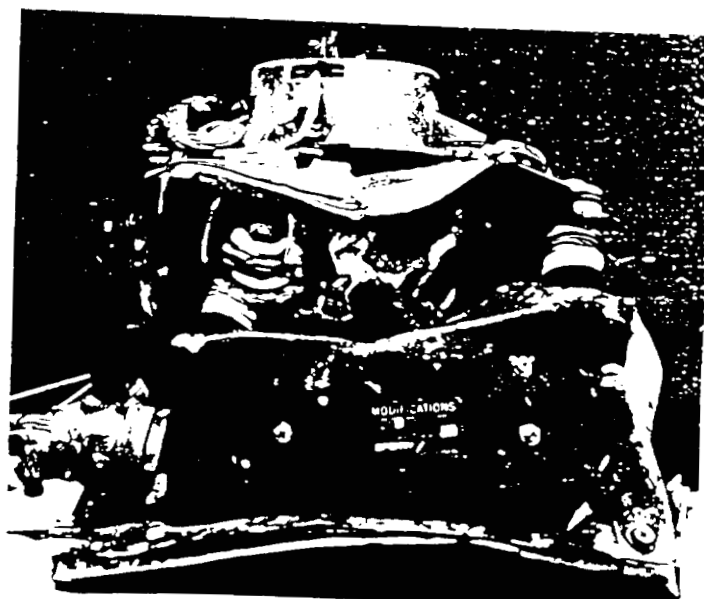
Unit had been smashed in from the top. Inspection sticker was intact. Gyro assy. was broken loose from base. Extensive water damage. Top slipping broken and brush block destroyed. The inner gimbal is level, within $\pm 10^\circ$. Unit had to be removed from bucket to excite synchros. Liquid level is intact, but broken loose from gimbal. Gyro rotor was also removed to get at synchro leads. Heading synchro checked OK, A/P synchro checked OK. Connectors checked OK. Gyro rotor continuity was OK, but rotor didn't run. A dent on one side may protrude far enough to prevent rotor from turning. Base electronics revealed nothing. The four screws holding the heading synchro ~~to~~ rotors to the gimbal were all loose - not stripped, apparently never tightened. If they back out far enough, they will drag and cause the inner gimbal to dump over, and ~~also~~ indicate an Invalid.

DG #1 : DG-206A 2388302-4 S/N 1037606 Last Repaired by Sperry/UK
8-14-87

Unit Inspection showed much more extensive damage than the previous unit. The unit was disassembled and synchros powered. A/P synchro worked OK. Heading synchro was damaged and didn't work. Base electronics revealed nothing.



DG #2: As received.



DG #1: As received.

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ACCOUNT NO.
SUBJECT

 **SPEERY**
FLIGHT SYSTEMS

NAME

DATE

DG#2: After Analysis



DG#1: After Analysis