

REPORT ON AIRCRAFT INCIDENT WHICH OCCURRED ON  
SUPER VC.10 5H-MOG - ON 10TH JANUARY, 1976

AIRCRAFT: SUPER VC-10 (1154) 5H-MOG - CONSTRUCTORS NO.885.  
OPERATOR: EAST AFRICAN AIRWAYS.  
SITE OF INCIDENT: NAIROBI-LONDON (DIVERTED ROME).  
CREW: TOTAL VC.10 HRS.  
CAPTAIN BRITCHFORD. 3933.56  
F/O MU YA 150.00  
E/O SERNA 1310.48  
N/O WARNER 3000.00  
F/O DOLASIA (SNY) 910.00  
PASSENGERS: 155 - UNINJURED  
SERVICE NUMBER: EC 660 NAIROBI LONDON DIRECT.  
DATE AND TIME OF DEPARTURE: 10TH JANUARY, 1976 - 10.35 A.M. LOCAL

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S U M M A R Y

During the take-off run from Nairobi Airport the First Officer's Airspeed Indicator at VR was under-reading by approximately 35 KTS which resulted in the appropriate calls not being made. It was subsequently established during the climb out that the Commander's pitot instruments were reading correctly but the First Officer's, Navigation Officer's and Engineer Officer's pitot operated instruments were in error. From this assessment the Commander of the aircraft elected to continue the flight which eventually led to the unairworthy operation of the aircraft that necessitated termination of the flight at Rome.

The failure of the Commander of the aircraft to identify the seriousness of the pitot system malfunction, and to establish beyond all reasonable doubt the position of flight deck pitot changeover cocks, in accordance with procedures prescribed in the Flight Manual, and deciding to continue the flight, are considered the fundamental causes of the resultant hazardous operation of the aircraft.

INVESTIGATION

History of the Flight

The aircraft was operating East African Airways flight EC 660, a scheduled service from Nairobi Airport to London direct.

The take-off run was initiated - Maximum Weight, Wind 060/10-15 KTS, Temperature 23°C, with the commander in the left hand seat piloting the aircraft and a trainee first officer in the right hand seat. All was normal up to 100 DTS with appropriate calls being made, but when the trainee first officer failed to call VI (137 KTS) the commander called it and handed the power over to the engineer officer.

Again at VR the trainee first officer failed to call so the commander called and chided the first officer who explained that his ASI was at that time reading 125 KTS when the commander's ASI was reading approximately 160 KTS.

Climb to FL 310 and cruise.

The initial climb out and clean up were made using the commander's ASI without incident. The No. 1 automatic pilot was selected and the climb started. As the climb progressed the First Officer's ASI reading increased to a figure higher than that of the commander's. As a result of this observation the aircraft was levelled at FL 200 and the speed allowed to build up to check the overspeed warnings. These operated at 324 KTS No. 1 and 330 KTS No. 2 as indicated on the Commander's ASI (The wasp was at 320 KTS). During these tests, the First Officer reported that on the pre-departure check he had found all pitot heaters, with the exception of the Commander's in the 'ON' position. Subsequently, pitot heater ammeters were checked and current flows were found to be normal. The Commander then assumed from the assessment made that his pitot operated instruments were functioning correctly and the F/O, N/O's and E/O's pitot instruments were in error.

The pitot changeover cocks were operated, which resulted in the over readings observed on the F/O's pitot instruments being transferred to the commander's instruments. As a result of this the Commander decided to return the changeover cocks to the normal position and having assumed all cocks to have been placed in this position continued the climb to FL 310. At the top of the climb the First Officer's ASI was reading 400 KTS.

The cruise was normal except that on reaching MALAKAL (9.5°N) fuel consumed was less than it should have been and the ground speed was approximately 30 KTS. down. The crew also noticed the tail trim to be in error by 0.2° the aircraft flying with a slight nose-up attitude. This led them to suspect a large overweight condition in the rear in addition to the pitot/static problem. The Captain re-added the aircraft loadsheet, found it correct, re-trimmed the balance sheet and found it only slightly in error.

On passing Malakal the Commander's Horizon Director Indicator attitude warning light illuminated and this was actioned by transferring the instrument to the No.2 Vertical Gyro.

At 16°N clearance was obtained to climb to FL 350 and as the aircraft was well within the 1.35 G buffet the climb was initiated at MACH 0.84 indicated. At about FL330 the aircraft encountered slight airframe buffet and to overcome this the Commander increased the Mach No. to 0.86 indicated for the remainder of the climb and initial cruise at FL350 and the buffet lessened. Indications from the aircraft Doppler system, confirmed by the Navigation Officer, were of very strong headwinds, but as these are not uncommon in this area no action was taken although the winds were very different from those obtained from a southbound aircraft at FL330 about 4 hours earlier. The aircraft continued to lose time, arriving Benina (32°N) approximately

35 mins. late with fuel remaining 800 Kgs. down. It was at this point that the Commander suspected the accuracy of his own pitot static instruments. At Benina the Commander's compass system developed synchronisation problems which necessitated selecting the DF mode of operation.

The cruise was continued at FL 350 with a drift change from 20°R to 5°L but the ground speed was still very low and at 37°N the aircraft was requested by Rome ATC to climb to FL 390 which the Commander was very reluctant to do. Nevertheless, a climb was started at Mach. 86 and the Commander instructed the E/O to watch the auto ignition lights. Buffet started almost as soon as the aircraft left FL 350 and at FL 370 the No.1 auto ignition illuminated and the Commander immediately elected to descend to FL 280 - the only alternative level available from Rome ATC.

The Commander was now certain that both pitot static systems were in error by varying amounts and as a result of this, coupled with the compass system and No.1 VG malfunction, decided to land the aircraft at Rome. Before a final decision was made to do so, clearance was obtained from Rome ATC, abeam Sorrento, to climb to FL 350 where a cruise was set up at Mach.88 indicated in an attempt to assess the magnitude of the observed errors. Snd wind at this time obtained from Rome Information indicated a 25 KT headwind, but the Doppler indicated 150 KT headwind confirming the low TAS and instrument error. Clearance was then obtained to divert to Rome, where the weather was CAVOK and wind calm.

In view of the slow transfer of the fin tank fuel, it was necessary to hold prior to landing and the auto throttle was checked which seemed to indicate that the Captain's ASI was indicating 15 KTS fast and the F/O's about 30 KTS fast at FL 60 with 180 KTS selected on the auto throttle controller.

A long approach was made by descending to 1000 ft. AGL at 5 nm. and a comparison between Doppler ground speed against the Captain's ASI gave 160 KTS - 167 KTS respectively (F/O's now read 175 KTS).

A satisfactory landing at Rome was made at 155 KTS with full flap at the threshold.

On arrival at Rome Airport the Commander of the aircraft made the following entries in the Maintenance Log for the aircraft, under the heading 'Aircraft Defects:-

1. Starboard pitot static system grossly over-reading  
Port system slightly over-reading.
2. Captain's HDI failure light 'ON'.

The entries were signed by Captain Britchford and dated 10th. January 1976. No reference was made to the No. 1 compass system malfunction which occurred at Benina.

DEFECT INVESTIGATION AT ROME

Reported flight defects were investigated and remedial action taken by British Airways Engineering in Rome under B.A. Approval Reference Number 944, which resulted in the following entries being made in the Aircraft Maintenance Log under the heading 'Rectification Action'.

1. NO. 1 AND NO.2 PITOT SYSTEMS CHECK CARRIED OUT LEAK TRACED AT FLIGHT DATA RECORDER LOCATED AT TAIL OF THE AIRCRAFT, BOTH PITOT AND STATIC LINE CONNECTIONS TO FLIGHT DATA RECORDER DISCONNECTED AND BLANKED OFF, SYSTEM LEAK CHECK CARRIED OUT SATISFACTORY. TRANSFERRED TO BASE DEFECT LOG.
2. TRANSFERRED TO BASE DEFECT.

Following this action the aircraft was prepared for a return flight to Nairobi and certified with the flight data recorder inoperative. On the 11th January the aircraft operated a scheduled service Flight EC 663 Rome - Nairobi direct without incident.

Primary cause of No.2 Pitot Static System failure.

On return from Rome, investigation into the cause of the pitot static system defect was initiated.

From this investigation the following points were established:-

1. During servicing of the aircraft by E.A.A. Engineering staff prior to flight EC 660 on the 10th January, clearance of a previous flight defect on the flight data recorder system necessitated the removal of a defective recorder unit. A replacement unit serial No.1773 was drawn from E.A.A. Bonded Stores and fitted to the aircraft in the early hours of the morning of the 10th January.
2. Flight Data Recorder Unit, serial No.1773 had been overhauled by EAA. Instrument Section, certified and directed to EAA. Bonded Stores on the 7th January, 1976. Subsequent to its certification this unit had been subject to malicious damage. From close examination it is believed the unit case had been removed and the internal pitot and static pipe unions interferred with. The pitot union nut located directly behind the front plate was found completely off its thread and the adjacent static union nut a little less than finger tight.
3. The resultant pitot static fault within the F.D.R. went undetected at the time of installation to the aircraft as the engineer responsible for its installation and certification failed to carry out the required pitot static leak check of the No. 2 system in compliance with the relevant aircraft maintenance manual.

2.

ANALYSIS AND CONCLUSIONS

2.1. ANALYSIS

The incident occurred as a direct result of an Inspection failure following a flight data recorder change during servicing of the aircraft by E.A.A. Engineering staff at Nairobi Airport, prior to flight EC 660 on the 10th January, 1976.

The high ASI and Machmeter readings observed in flight were the result of cabin pressure entering the No.2 pitot system at the flight data recorder internal pitot union. For example: At FL 310 (287 Mb) assuming a cabin pressure of 8000 ft. (753 Mb) the differential pressure would have been in the order of 466 Mbs - or equivalent to 500 KTS. Taking the leak rate through the P1 pitot head into consideration the composite effect of pressure applied to the pitot system is estimated to be in the region of that displayed i.e. 400 KTS.

In view of the reliability status of flight deck instrumentation with which the crew were confronted during the initial climb out from Nairobi, it might have been expected that the commander would have considered it prudent to have returned with the minimum of delay. However, it was the commander's decision, based on the assumption that the accuracy of his own instrumentation was in no way affected, to continue the flight. It is believed that had the crew at that time investigated the No. 2 pitot system failure with a little more precision and in accordance with procedures prescribed in the Operations Flying Manual, the situation which later developed might well have been avoided.

The operations Flying Manual, Section 4-34-4 Page 1 under the heading "Alternative Pitot Sources" states that:

"The failure of a Normal Pitot Source will be indicated by malfunction of the ASI and mach-meter on that side. If alternative Pitot Source (on the unserviceable side) is selected and the affected instruments return to normal the fault is probably due to a blocked pitot tube caused by ice, bird-strike etc. Both sets of instruments are now being supplied by the serviceable source; no correction to the indicated readings will be necessary.

If however, the fault is in that part of the system within the pressurised area, both sets of instruments will be affected when alternative Pitot Source is selected on the unserviceable side. In this case the Normal Pitot Source should be selected on BOTH sides and the aircraft flown by reference to the serviceable instruments only".

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2.2. CONCLUSIONS

(a) Findings:

1. The aircraft's documentation was in order.
2. The crew members were properly licenced.
3. The commander's previous experience on SVC.10 was 3933.56 Hours.
4. The co-pilot's previous experience on SVC.10 was 150 hours.
5. The crew was properly rested prior to the flight.
6. A discrepancy between the reading of the commander's and co-pilot's ASI's developed during the take off run.
7. During the in-flight investigation, the defect was spread across from one system to the other by apparently random operation of the pitot selector valves.
8. The crew did not correctly carry out the instructions laid down in Section 4.34.4. of the Operations Flying Manual.
9. The flight deck instrumentation correctly indicated the system failure.
10. The commander assumed, incorrectly that after carrying out these checks that his instruments, were reading correctly, and that the co-pilot's pitot selector had been returned to its normal position.
11. There was evidence of a pitot system malfunction together with the knowldege that the aircraft's ground speed was approximately 30 knots below that expected at an early stage.
12. The crew believed that the low ground speed and slight nose up attitude might have been the result of an excessive overweight condition.
13. On inspection after landing at Rome a serious pitot static leak was discovered in the Flight Data Recorder Unit.
14. Subsequent investigation revealed that this unit had been tampered with prior to its fitment on the aircraft.
15. The engineer responsible for its fitment failed to carry out the required leak check in accordance with the appropriate maintenance manual.

(b) Cause:

The incident was caused by the commander failing to correctly identify a failure in the No. 2 Pitot/Static system, which, had been caused by an inspection failure of the engineer responsible for fitting an unserviceable component to the aircraft.

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The commander stated that during the initial climb, in order to diagnose the pitot system malfunction the Pitot selector Valves (see Appendix A) located on the lower portion of the Left and Right Consoles were operated and that this had the effect of transferring the high readings observed on the Starboard instruments to the Port instruments. Accordingly he decided to return them to their normal positions. On doing so on his own panel he had assumed the trainee co-pilot to have done the same although no specific instruction to do so was issued. The commander further stated that he was unable to confirm the position of the co-pilot's selector as it was not visible from his seat.

The trainee co-pilot stated that in an endeavour to assist in the investigation, he, together with the remainder of the crew, consulted the Flight Operation Manual which, contrary to the recommended procedures contained therein for the particular set of circumstances, led to the alternate pitot source P1 being selected on his panel where - to the best of his knowledge - it remained throughout the flight. It is believed the commander had not been advised of this action which resulted in cabin pressure being exhausted to atmosphere through the commander's pitot head P1 (see Appendix B). It is impossible to calculate from the limited data available the effect in numerical terms this would have had on the commander's ASI and Machmeter at the particular height and speed of the aircraft when the selection was made, but in all probability taking into account the cabin air leak rate against P1 pressure would have been in the same order which would explain the action having gone un-noticed by him.

From the foregoing it is reasonable to deduce that any departure from the existing altitude would have now been reflected on the aircraft ASI's and Machmeters as a change in speed. For example: An increase in aircraft altitude would effectively increase the differential between the now cabin pressure in the pitot line and normal static pressure applied to these instruments, resulting in increased readings being displayed. It is further considered that discrepancies observed between the commander's and co-pilot's ASI/Machmeters in this configuration can be attributed to turbulence generated as a result of the cabin air flow rate within the system.

Conclusions drawn from the investigations into the incident, indicate a case of flight deck mismanagement insofar as imprecise direction and research into a malfunction of the aircraft's No. 2 pitot system. It became apparent from assessment of evidence that the basic cause of the incorrect pitot selection made by the trainee co-pilot, and it going unchallenged by the remainder of the crew, was the absence of co-ordinated direction and monitoring of events during the in flight investigation into the problem. It appears that in an endeavour to isolate the problem in the minimum amount of time, the alternate pitot sources were selected at random without the resultant effects being properly evaluated which culminated in the co-pilot's selector being left - contrary to the recommendations prescribed in the flight manual - in the alternate P1 position, resulting in the unairworthy operation of the aircraft.

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(b) Cause:

The incident was caused by the commander failing to correctly identify a failure in the No. 2 Pitot/Static system, which, had been caused by an inspection failure of the engineer responsible for fitting an unserviceable component to the aircraft.

3. RECOMMENDATION

It is recommended that consideration be given by the Corporation, to include ASI Machmeter parameters similar to those experienced in this report on the No. 2 pitot system of the VC. 10 flight simulator in order that crews of VC.10 aircraft receive training in the operation of pitot selector valves applicable to this particular set of circumstances.

It is recommended that the engineering department take the necessary action to ensure that better **supervision and quality control** be enforced.

4. COMPLIANCE WITH REGULATIONS

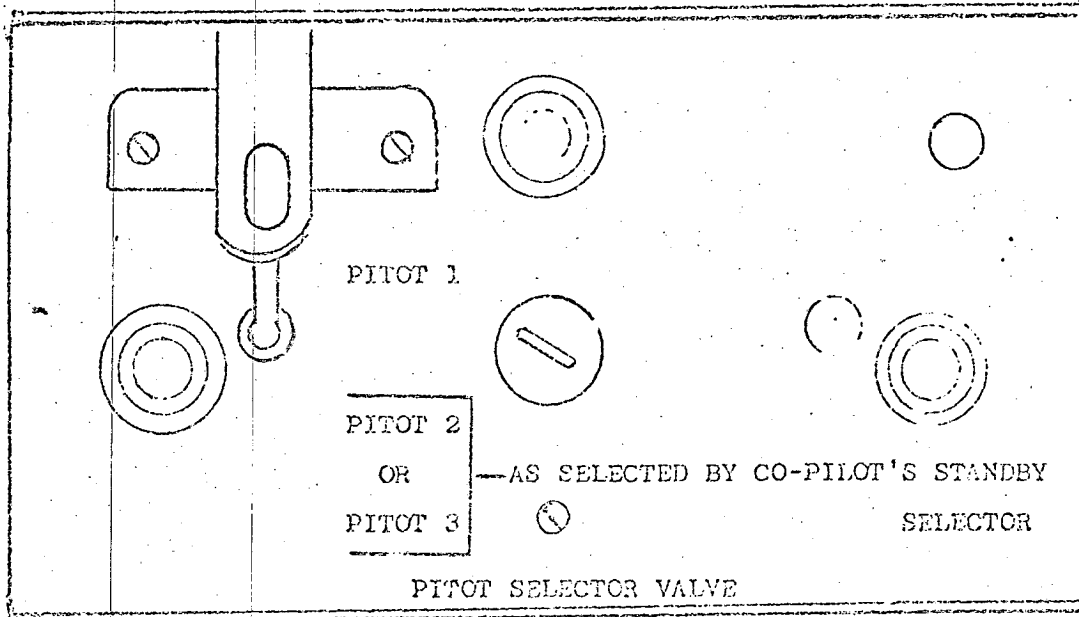
In conducting this investigation, the Provisions of Regulation 7(5) of the Civil Aviation (Investigation of Accidents) Regulations 1970 have been complied with. All interested parties were offered the opportunity of exercising the rights conferred by the Regulation.

All concerned indicated that they wished to make certain representations; these were taken into consideration by the Investigation and have been taken into account in preparing the Report. It was not considered necessary to alter the opinion as to the cause of the incident.

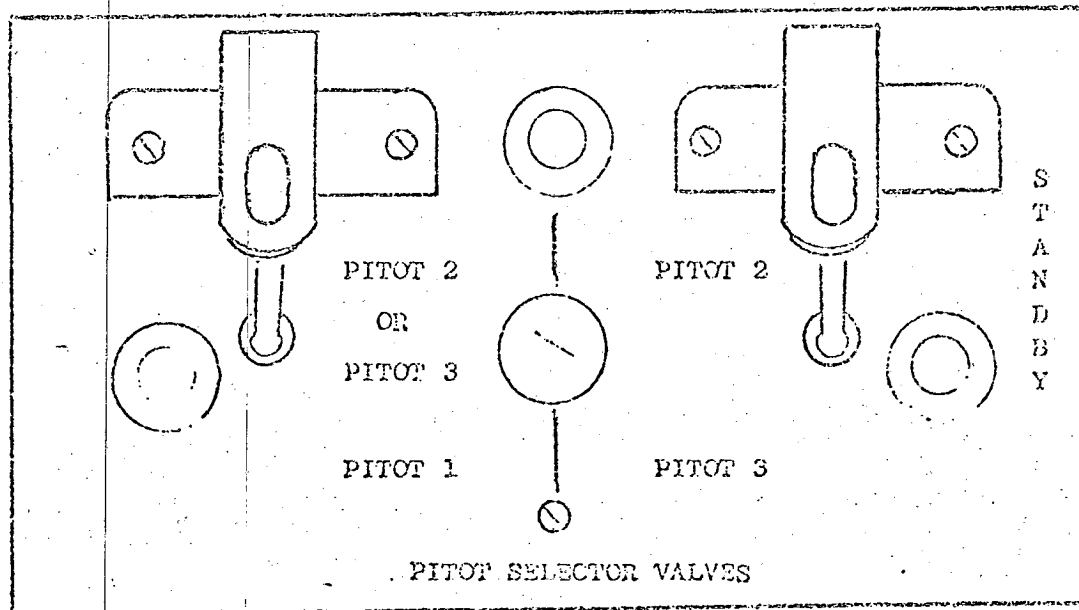


(D.C. Stewart)  
CHIEF INSPECTOR OF ACCIDENTS

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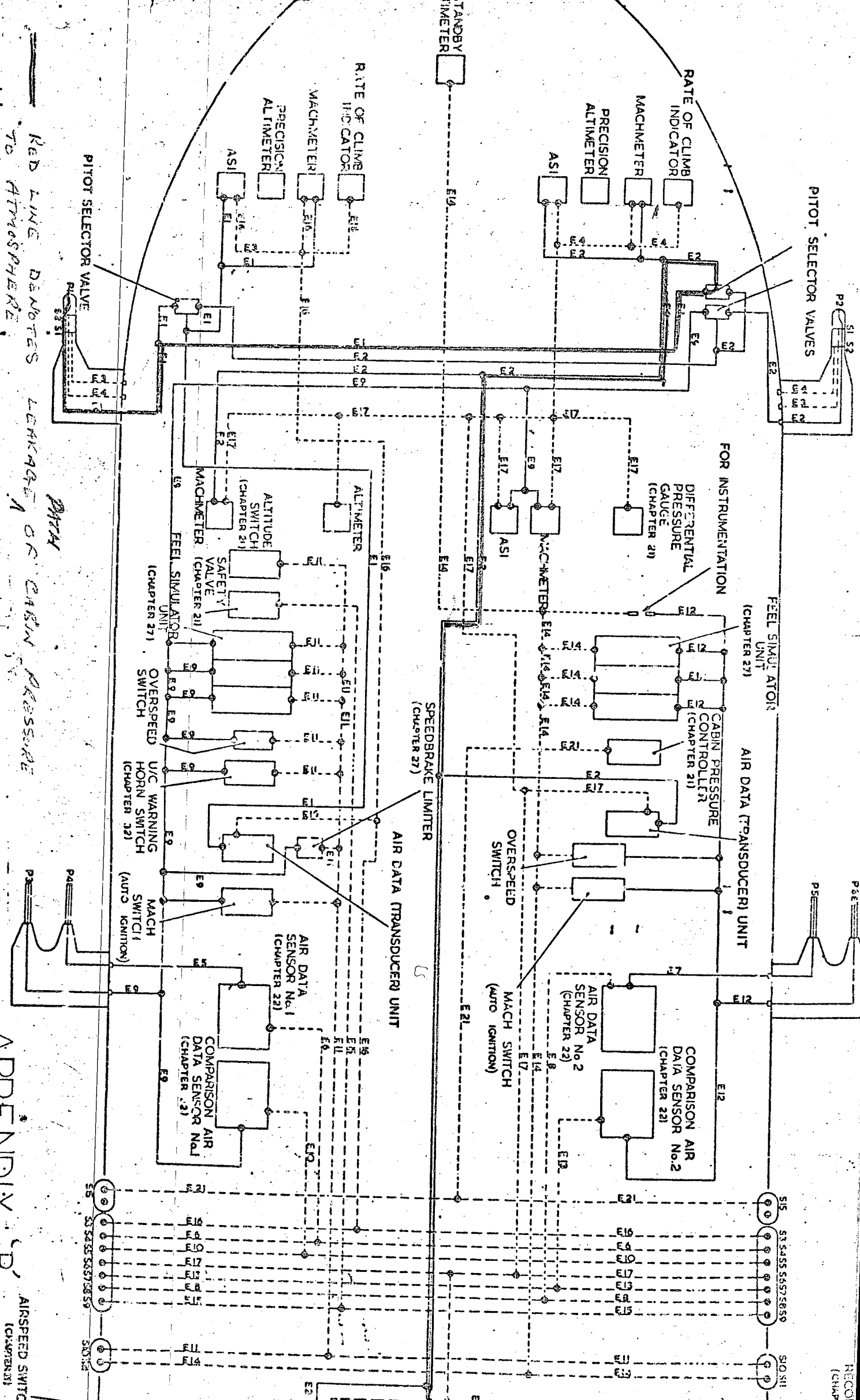


ALTERNATIVE PITOT CONTROLS AT LEFT CONSOLE  
(CAPTAIN) FIGURE 1.



ALTERNATIVE PITOT CONTROLS AT RIGHT CONSOLE  
(CO-PILOT) FIGURE 2.

Diagram of Pitot Controls on the Flight Deck



RED LINE DENOTES LEAKAGE IN CABIN PRESSURE TO ATMOSPHERE

APPENDIX 'B' AIRSPEED SWITCH (CHAPTER 21)