No. 7

Cathay Pacific Airways, Convair 880-22M, VR-HFZ, accident, near Pleiku, South Viet-Nam, on 15 June 1972. Report dated 22 September 1972, released by Director of Civil Aviation, Republic of Viet-Nam

1.- Investigation

1.1 History of the flight

Flight CX 700Z was a scheduled international flight from Singapore to Hong Kong with an en-route stop at Bangkok. It made a 55 minute stop at Bangkok during which 68 passengers and baggage were off loaded, and 35 passengers and baggage, in addition to 35 000 lbs of JP-1 fuel, were loaded. The aircraft took off from Bangkok at 0455 hours GMT bound for Hong Kong via airway Green 67 at FL 290. The flight proceeded normally with the aircraft maintaining routine radio contact first with Bangkok ACC and from 0542 hours with Saigon ACC. The last message from the aircraft was received at 0554 hours by Saigon ACC giving the aircraft's position at 0553 hours over reporting point "PE5" at FL 290, with an estimated time over "XVK" reporting point of 0606 hours. At 0620 hours, when no further messages had been received from the aircraft, Saigon ACC called it several times but received no reply. A request for information concerning the aircraft, made by Saigon ACC at 0640 hours to Hong Kong and then Taipei ACCs, produced negative results. The Distress Phase was initiated at 0715 hours and DETRESFA signalled to Tan Son Nhut RCC for appropriate action. The RCC advised Saigon ACC at 0755 hours that a Convair type aircraft had crashed about 30 NM south east of Pleiku TACAN beacon. The aircraft was identified as VR-HFZ by two helicopter pilots who reached the accident site soon after the occurrence and while the wreckage was still burning. They recovered two bodies from the burning wreckage and flew them to Pleiku.

The accident occurred at about 0559 hours.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	10*	71*	
Non-fatal			
None			

*includes 2 crew and 8 passengers missing believed killed.

1.3 Damage to aircraft

The aircraft was destroyed.

1.4 Other damage

There was no other relevant damage.

1.5 Crew information

The pilot-in-command, aged 42, held a valid airline transport pilot's licence endorsed for Convair 880-22M aircraft and a current instrument rating. He was the Company Flight Captain of the CV880 fleet and was seated behind the left pilot's seat for the purpose of checking the co-pilot under pilot-in-command training. At the time of the accident he had flown a total of 14 343 hours including 5 261 hours in Convair 880-22M aircraft. His last medical examination took place on 2 May 1972, and there were no limitations imposed. He had flown 49 hours in the last 28 days and had been off duty 13 hours 35 min before this flight.

The co-pilot, aged 38, held a valid airline transport pilot's licence endorsed for Convair 880-22M aircraft, and a current instrument rating. At the time of the accident he had flown a total of 7 649 hours including 2 687 hours in Convair 880-22M aircraft. His last medical examination took place on 19 May 1972, and no limitations were imposed. He had flown 87 hours in the last 28 days and had been off duty 13 hours 35 min before this flight.

The Second Officer, aged 42, held a valid airline transport pilot's licence endorsed for Convair 880-22M aircraft and a current instrument rating. At the time of the accident he had flown a total of 5 783 hours including 1 529 hours in Convair 880-22M aircraft. His last medical examination took place on 13 June 1972, and there were no limitations imposed. He had flown 66 hours in the last 28 days and had been off duty 13 hours 35 min before this flight.

The Flight Engineer, aged 36, held a valid flight engineer's licence and had passed a recent proficiency check. He was the Company Senior CV880-22M Check Flight Engineer. At the time of the accident he had flown a total of 4 246 hours including 2 959 hours in Convair 880-22M aircraft. His last medical examination took place on 10 August 1971, and there were no limitations imposed. He had flown 42 hours in the last 28 days and had been off duty 13 hours 35 min before this flight.

Also aboard were six flight attendants who had undergone recurrent training during the 6 months prior to the accident.

1.6 Aircraft information

The aircraft was constructed in 1961 by the Convair Division of the General Dynamics Company in the USA. It was purchased by the airline in 1967 with a total flight time of 13 295 hours. At the time of the accident it had flown a total of 29 434 hours. Its certificate of airworthiness was valid until 23 August 1972. The aircraft had been regularly maintained in accordance with the Company's continuous maintenance and progressive overhaul system. The certificate of maintenance issued on 11 May 1972 when the aircraft had flown a total of 29 139 hours was valid. A routine transit check was carried out at Bangkok prior to the flight; no discrepancies were found and the aircraft was subsequently certified as operational for further flight.

The technical log records for the aircraft, the engine and equipment revealed no history of significant or repetitive defects which could have contributed to the accident.

The weight of the aircraft at take-off from Bangkok was 178 627 lb, well below the maximum authorized take-off weight of 193 000 lb, and its centre of gravity was at 29.7 per cent MAC within allowable limits.

At the time of the accident the weight of the aircraft was computed as being 162 627 lb and its centre of gravity as 29.1 per cent MAC.

1.7 Meteorological information

The weather forecast from the satellite picture for the Pleiku area, indicated scattered cumulus at 3 000 to 6 000 ft with isolated cumulus build ups towering to 15 000 ft, and thin cirrus at 30 000 ft to 32 000 ft.

The pilot of a Navy aircraft flying over the Pleiku area at 0600 hours reported scattered cumulus clouds at 2 000 ft with tops at 3 500 to 6 500 ft and cumulus build ups towering to 16 000 ft.

The estimated upper level winds obtained from facsimile charts were as follows:

0000 hours	FL100:	260°/08 knots	1200 hours	FL100:	280°/10 knots
	FL180:	240°/15 knots		FL180:	280°/10 knots
	FL300:	120°/25 knots		FL300:	080°/20 knots

There was no evidence of clear air turbulence or marked vertical wind shear at FL290 and it appears that the aircraft was flying in either clear air or in thin cirrus cloud at the time of the accident.

The accident occurred in daylight.

1.8 Aids to navigation

The aircraft was fitted with standard navigation equipment which included two ADF and VOR sets, and the crew had not reported any unserviceability.

The Pleiku NDB was operating on a test basis; the Qui Nhon NDB was serviceable and operating. It was normal IATA recommended practice to follow the southern edge of the airway in this area until close to Qui Nhon; the flight data recorder revealed that at the time of the accident the aircraft had altered course to intercept the centre line of the airway before flying over Qui Nhon.

1.9 Communications

The en-route air/ground communications recording could not be obtained due to the malfunctioning of the ATS tape recorder. However, normal VHF communications were maintained throughout the flight until the aircraft reported passing over the reporting point "PE5", after which no further communication was received from the aircraft. No communication indicating evidence of either distress or emergency was ever received.

1.10 Aerodrome and ground facilities

Not relevant to this accident.

1.11 Flight recorder

The aircraft was equipped with a Fairchild 5424-241A Flight Data Recorder, which had been calibrated by the manufacturer on 20 April 1972, but it was not equipped with a Cockpit Voice Recorder.

The Flight Data Recorder was located at the rear of the aircraft at station 1264, on the port side beneath the floor near the entrance door. The electrical wiring was routed from the flight deck junction box passing beneath the floor on the starboard side of the aircraft just outboard of the centre passenger aisle. The pitot and static lines passed under the floor on the port side of the aircraft in close proximity to the cabin wall. The recorder was recovered at its normal location. As a result of ground impact the case was severely distorted and it was not possible to extract the cassette by the normal method. When finally extracted the metal foil recording medium was found to be intact for the whole of the recording period but was torn subsequent to this. Parameters for time, altitude, indicated airspeed (KIAS), magnetic heading, pitch attitude and vertical acceleration (vertical acceleration meter located at station 828) were satisfactorily recorded, but the event-marker facility, indicating when the radio was used, had not operated.

The read-out indicated that the accident occurred 64 minutes and 2 seconds after take-off from Bangkok, that is at 0559 hours, five minutes after the last message was received from the aircraft and that the aircraft was flying normally at 29 000 ft, at an IAS of 310 kt, on a heading of 071 degrees, with a normal pitch attitude of minus one to minus two degrees until that time. The NTSB comprehensive read-out indicated that electrical power was available to the Flight Data Recorder for a further 30 sec; however, the traces were considered random traces and bore no relationship to aircraft performance.

1.12 Wreckage

The aircraft crashed in a jungle area, lightly wooded with small trees. The area was subject to war activity.

The main wreckage trail was oriented on a heading of ESE and covered an area of 2 400 m by 1 500 m. It was clear from the distribution of the wreckage that the aircraft had disintegrated in flight. Due to the nature of the site and the close proximity of enemy forces it was only possible to make a cursory examination of the main sections of the wreckage. The aircraft broke into three main sections (see Fig. 7-1) the section of the fuselage forward of the wing leading edge, the wing complete with centre section, and the rear fuselage aft of the wing trailing edge. The wing and centre section had been extensively damaged by fire, and most of the passenger cabin located over the wing had been destroyed.

All components impacted the ground in a flat attitude after vertical descent. With the exception of the rear fuselage section all came to rest in an inverted position.

All cabin doors and baggage compartment doors were in a closed and locked position prior to impact.

Both main landing gear assemblies separated from the aircraft during the break-up sequence. Both were recovered in a damaged condition. Examination of the forward fuselage section indicated that the nose gear was in a retracted position prior to this section of the fuselage impacting the ground.

The wing and fuselage centre section was almost destroyed by the fire which occurred after impact. However, examination of the flap screw-jack actuators revealed that the flaps were in a retracted position at the time of impact.

No. 3 engine was located and examined on the ground. Two engines and many small pieces of wreckage and other debris (including the rudder) were seen from a helicopter in the surrounding jungle area, but were not examined. The other engine was not located.

The early discovery that the undercarriage beam had broken into two pieces immediately narrowed the field of investigation. The beam which contained a number of unusual fractures, and parts of the fuselage skin which were still attached to it were removed to a hangar and subjected to detailed examination. During this examination a small high velocity impact crater and explosive 'Splash', typical of that found in other aircraft subject to an explosive blast, was discovered in a piece of fuselage skin from the port side of the passenger cabin centre section. This was the first positive evidence of an explosion occurring most probably inside the aircraft passenger cabin.

An X-ray examination of all recovered bodies was carried out in order to determine if any of them contained metal or other particles consistent with the explosion of an explosive device inside the aircraft. Nine bodies were found to contain unusual particles and some of these particles were removed for laboratory examination.

A further examination of the remaining accessible pieces of the wreckage at the accident site revealed a complicated and most unusual mode of break up of the structure. There was no evidence to suggest that a weakness in the structure or that overleading due to aerodynamic forces was a primary factor in the airframe break up, but further evidence consistent with an explosion having occurred in the passenger cabin centre section in flight was found. A piece of the starboard side wing root structure close to the fuselage side was found to contain very high velocity penetrations, accompanied by a number of minute craters typical of having been formed by a high explosive blast in close proximity. All these penetrations had been formed by small fragments moving from the inside towards the outside of the aircraft. No failure of an aircraft system, engine or component could achieve the high velocities necessary to cause this type of damage.

It appeared that not only did the explosion cause major structural damage and possible loss of control with subsequent break up but that it also ruptured No. 3 fuel tank and that fuel leaking from the tank ignited prior to the aircraft's final disintegration. At least one body and possibly some seats struck the top of the vertical stabilizer after being ejected from the passenger cabin. Other debris struck the horizontal stabilizer causing the actuating jack to break and separate from the stabilizer. The stabilizer then separated from the aircraft. From the relatively close proximity on the ground of the three main sections of the wreckage (the forward fuselage, the centre section and wing, and the aft fuselage) it was apparent that the main and secondary break up occurred at a comparatively low altitude.

1.13 Medical and pathological information

Of the 81 persons on board the aircraft only 71 bodies were recovered and identified. By the time the pathologists were able to commence their examinations 10 to 12 days had elapsed since the accident. However, 69 bodies were subjected to X-ray examination; of these 9 were found to contain deeply imbedded opaque fragments which were not likely to have resulted from a normal aircraft accident, but were consistent with the effects of an explosive device. Some of these fragments were recovered and sent for laboratory examination (see paragraph 1.16).

1.14 Fire

Evidence suggested that fire occurred as a result of fuel escaping from No. 3 fuel tank which was apparently ruptured by the explosive device, and that this area was burning when it struck the ground. On the ground the fire spread to fuel contained in the wing section, and the whole of the wing span and centre section was then almost completely consumed.

1.15 Survival aspects

The accident was not survivable.

The wreckage was first sighted and reported by a VNAF pilot soon after the accident at 0615 hours, and two helicopters were diverted to the site. The pilots of the helicopters recovered two bodies and flew them to Pleiku. They returned to the site together with a District Chief Officer at 0700 hours; it was then established that there were no survivors and the RCC was informed accordingly. A rescue team reached the scene at 0300 hours on 16 June and the remaining bodies were recovered by helicopter. Those bodies which were not recovered may have been burned by the fire on the ground, or ejected from the aircraft at high altitude and have come down in the jungle some miles from the wreckage site.

It was considered highly probable that all passengers and crew were rendered unconscious by the explosive decompression which followed the detonation of the high explosive device. The exact cause of death of the passengers and crew could not be determined.

1.16 Tests and research

Following the initial examination, specimens were taken from the aircraft wreckage and metal particles were extracted from a number of bodies (see Fig. 7-1). These were examined at the United Kingdom Royal Armament Research and Development Establishment, Woolwich.

Chemical analysis was used in an effort to determine the type of explosive involved in the accident but it proved inconclusive due to the elapsed time, weathering and the nature and circumstantial history of the various specimens of evidence. However, experimental tests using a typical high explosive, contained in a thin mild steel container, did produce a pattern of craters very similar to those found in the wing root specimens recovered from the wreckage of the starboard wing.

The small craters found in the wing root specimens were characteristic of very small metallic particles, some less than 1 mm in diameter travelling at very high velocities such as could only be imparted by the detonation of a high explosive device. The very small craters from the high velocity fragments could be expected to be found only within a few metres of the point of detonation. They were moving from inside towards the outside of the fuselage.

The majority of the metal particles recovered from the bodies were found to be of mild steel composition in a nodular form, probably from the case of some type of container used to enclose the explosive. The shape and size of the particles indicated the casing to have been of very thin metal construction. It was noted in particular that fragments from this very thin material were in marked contrast to the very numerous fragments produced by typical military missiles or projectiles which are normally much

larger, square, heavier, and thicker and which, with their much greater energy, are designed to penetrate and shatter an aircraft over its entire length, particularly from underneath. No such penetration or fragments were found. Furthermore, the missile body, after the warhead had been detonated, would have fallen on a free trajectory, and some of its large and distinctive structure would have been found somewhere in the wreckage trail of the aircraft. No such material was discovered. In addition, the radar observers would normally have seen a missile trace, and it is quite likely that witnesses on the ground would have seen a bright light from the tailjet of a missile. There was no such evidence. In conclusion, the metal particles extracted from the bodies bore no resemblance to any known missile, and evidence indicated that a high explosive device was detonated within the aircraft, with the generated particles moving outwards.

2.- Analysis and Conclusions

2.1 Analysis

The disposition of the wreckage and the inspection of the site indicated that structural failure of the aircraft occurred in the air. The possibility that this resulted from a collision with another aircraft was eliminated by reference to the civil and military records of aircraft movements, and by the fact that no evidence was found to indicate that a collision with another aircraft may have occurred.

The starboard side wing root structure close to the fuselage exhibited damage which could only have resulted from the detonation of a high explosive device in close proximity inside the aircraft. In addition, the fuselage floor skin on the port side of the aircraft in the passenger cabin centre section area, contained a crater typical of that resulting from a very high velocity impact by a particle from an explosive device. Furthermore, nine of the recovered bodies contained many deeply embedded mild steel fragments consistent with the detonation of a high explosive device in their immediate vicinity. The seat allocation list showed that some of these passengers were seated in the centre section of the cabin.

Due to the effects of the fire, particularly on the ground, and the fact that it was not possible to examine all of the wreckage, an assessment of the amount of damage caused initially by the explosion could not be made. However, the general sequence of break up of the aircraft was considered to have occurred in the following manner: upon the detonation of a substantial, high explosive device within the passenger cabin centre section area, the fuselage disrupted and some passengers' seats were ejected. Portions of the fuselage and possibly some seats struck the vertical and horizontal stabilizers, causing severe damage; at least one body struck the vertical stabilizer. Simultaneously the floor of the cabin, centre fuselage section, and starboard wing root were disrupted. It is highly probable that at this stage the flying controls routed beneath the floor in the centre section were damaged and this together with the stabilizer damage led to a loss of control which brought about a progressive break up of the aircraft structure in the consequent erratic high speed manoeuvres. It would appear that at a later stage the horizontal stabilizer was again struck by debris causing the stabilizer to separate from the rear fuselage section.

2.2 Conclusions

(a) Findings

(a) The aircraft was airworthy and its documentation was in order.

(b) The flight crew was properly licensed and experienced to carry out the flight.

(c) The flight was progressing normally under the correct handling of ATC units and in accordance with rules of the air and procedures.

(d) No hazardous weather conditions were encountered.

(e) A high explosive device detonated within the passenger cabin while the aircraft was cruising at FL 290.

(f) The explosion severely damaged the aircraft causing an out-of-control condition (possibly followed by fire) and structural break-up at a lower altitude.

(b) Cause or Probable cause(s)

The aircraft broke up in the air and caught fire following the detonation of a high explosive device within the passenger cabin.

3.- Recommendations

1. Airport authorities should ensure that adequate security measures are enforced (refer to ICAO report on this subject).

2. It is strongly recommended that the proper authorities discourage the sale of in-flight insurance at airports in line with ICAO recommendations.

3. It is strongly recommended that the Insurance Companies advise the airport authorities and the airlines when passengers are insured for large sums on short term.

4. Install cockpit voice recorders in all large public transport aircraft.

5. Consider use of non-flammable seat numbers on seat belts.

6. Recommend recording of crew finger-prints and dental records.

7. It is recommended that passengers be allocated seat numbers and asked to respect this number and remain in this position during flight. Records of seat plans should be retained at point of departure.

8. An aviation pathologist should accompany the initial team to arrive at the accident site.

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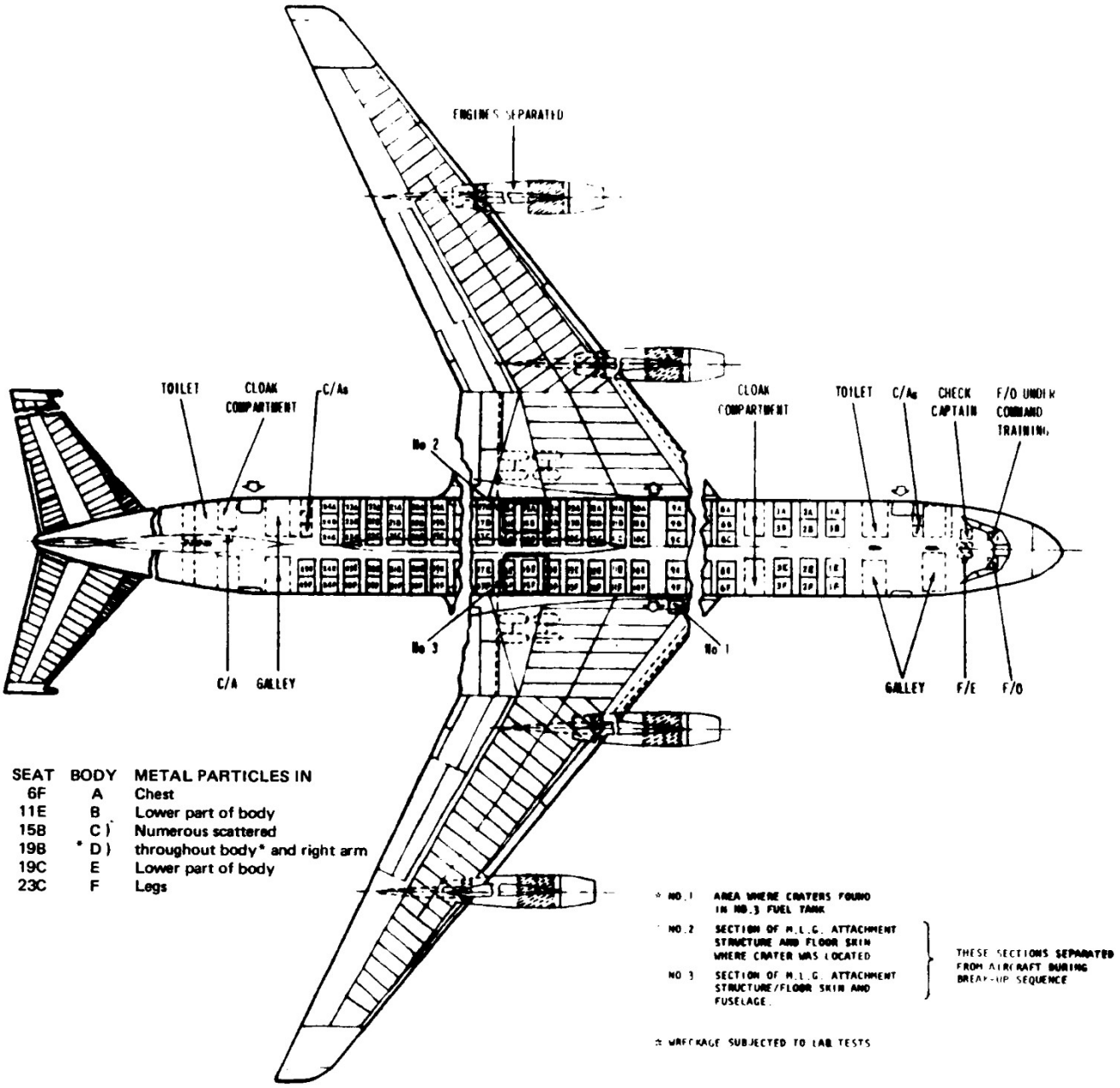

Figure 7-1.- Chart showing aircraft break-up points, wreckage subject to laboratory tests and seat allocation of bodies from which metal particles were removed.