

INVESTIGATION AND STUDY OF THE ACCIDENT

1. Aircraft type and number: C-46D, B-908
2. Time of accident: 1738-1740 (approximate), 20 June 1964
3. Air route: Taipei/Taichung/Tainan/Makung/Kaohsiung/Makung/Tainan/Taichung/Taipei.
4. Place of accident: Rice paddy and ditch (approximately 24°14', 120°41') west of San-Chien-Li-Chen and east of San-Cho-Chen, about 5 miles north/northeast of Suinan Airfield.
5. Conditions at scene of crash:

The left wing struck the ground first and part of the nose struck the paddy, forming a circular pit of a radius of more than 10 feet. The left wing broke immediately and the fuel tank was thrown out. The right wing broke upon impact with ground, its fuel tank was also thrown out and showed indications of burning. As the left wing and nose hit the ground, the tail broke and the airframe turned and broke apart. The passengers and seats were scattered around. Both main landing gears were detached from airframe. The wreckage spread from southeast to northwest up to 500 feet, width of wreckage area being about 200 feet. Evaluations based on scene of crash:

- (1) According to eyewitness Mrs. K. S. Hsu, a farmer's wife, the aircraft struck the ground with left wing lowered, somersaulted and broke apart. As the wreckage was in one place, no air explosion appeared to have occurred.
- (2) The broken state of the remnants, the death of all aboard and the conditions of their wounds indicate an absence of preparation for emergency landing, the impact with ground being made at great speed and with great force. This is supported by the flaps being in up position, by the cockpit having broken into pieces with only an altimeter being found, and by the extent of the pit created by the nose impact.
- (3) No indication of extensive fire was noted. According to eyewitnesses, fire broke out only upon impact with ground, as was also seen by the police who first arrived at the scene. The tail, fuel tanks and paddy showed signs of burning. Suinan Tower also noted black smoke in the northeast. Chinese Air Force Headquarters' report noted absence of abnormalities after takeoff.

6. Air Traffic Control

According to Suinan Tower and confirmed by Kungkuan Tower, B-908 departed Suinan at 1735L using runway 18 (north to south) and called via VHF "B" channel (126.18): "CAT B-908 leaving channel, see you tomorrow" without further contacts. At about 1740L, Suinan Tower saw black smoke rising from the ground in the northeast several miles away, called B-908, and could obtain no response. Kungkuan Tower then immediately contacted the search and rescue unit. Thus the accident did not arise from causes related to air traffic control.

APPROVED FOR  
RELEASE DATE:  
13-Mar-2009

7. Weather

As reported by Kungkuan Tower: Visibility 10 (1) 20 (11) 120 SW6 29.72

According to Taipei Weather Station:

Taichung at 0900Z, cloud coverage 5/8, wind direction 230°, wind speed 6, visibility 10, 2/8 CU 2800, 5/8 AC 12000, temperature 31°, dewpoint 26°, altimeter setting 29.72.

Kungkuan at 0900Z, cloud coverage 6/8, wind direction 230°, wind speed 16, visibility 15, 1/8 CU 2500, 6/8 CI, temperature 29°, dewpoint 24°, altimeter setting 29.72.

Thus, the weather was fine with moderate wind and fine visibility and could not be a factor leading to the accident.

8. Communications: Normal

9. Aircraft

- (1) Certificate of Airworthiness 52-54-338 issued October 30, 1964 valid up till October 29, 1964. Airworthiness check was made by qualified mechanic K. T. Mok and endorsed by CAA Inspector A. Wueste.
- (2) Airframe time up till June 19, 1964 was 19484:42 hours. Left right engine time was respectively 224:15 hours and 306:47 hours. This type of engine (K-2800) has an approved TBO of 1,400 hours.
- (3) Authorized weight for C-46 is 48000 lbs for takeoff and 46800 lbs for landing. The takeoff weight at time of departing Suinan was 45,994 lbs., which was within the authorized limit.

10. Pilots

Captain B. Lin graduated from CAF Flying School and U.S. Flying School and Instrument Flying School, having received complete and solid training. He was a CAF Pilot Officer and served as Check Pilot of Far East Flying School in Hongkong. He later joined CAT as copilot and served as Captain at time of accident. He held a valid Airline Transport Pilot License No. 10220, with valid MEL, DC-4, C-46 and Instrument ratings. He had 8,650 hours as pilot-in-command, 1,481 hours as copilot, 778 night flying hours and 1,544 instrument flying hours.

M. H. Kung held valid Senior Commercial Pilot License No. 20018, with valid MEL, MES, Instrument, C-46, DC-4 and PBV-5A ratings. He had a total of 14,911 flying hours.

11. Eyewitness

According to eyewitness Mrs. K. S. Hsu, the aircraft left wing which was lowered first struck the ground, the nose then hit the ground, followed by the right wing. The plane turned, broke apart, and burned, the time of crash being about 1740L.

12. Preliminary Evaluation

Based on the above, the aircraft crashed between 1738L and 1740L. As it made a left turn in climbing after takeoff and as the crash scene was 5 miles from Suinan, estimated altitude was 1200/1400 feet. Certain trouble possibly occurred during the climb and although the pilot attempted to turn to Kungkuan for landing, the plane crashed from loss of control.

13. The above represents a preliminary evaluation. The true cause may be determined only after examination of the remnants and further study by the experts.

SUINAN TOWER REPORT ON CAT B-908 ACCIDENT

1. Time of accident: About 1740, 20 June 1964
2. Weather conditions: Visibility 10 , (1) 20, (11) 120, SW 6, 29.72
3. Details of accident:

CAT's B-908 (C-46) took off for Taipei at 1735, using runway 18 (north to south). After takeoff, it turned to the left, quit traffic pattern and called over VHF B channel to say: "CAT 908 leaving channel. See you tomorrow." At 1740, black smoke was seen rising from ground several miles to the northeast. We immediately called B-908 by radio but received no response. Kungkuan Tower at the same time was asked to call by radio and to advise Taipei Control Center and other concerned units for search and rescue. We also advised Suinan Base Operations and Chief Duty Officer.

F. S. Wang  
Captain  
Officer-in-charge

KUNGKUAN TOWER STATEMENT

At 1747L, Suinan Tower OIC advised that according to Suinan Fireman, explosions and crash occurred near Chen-Ping. We learned of this at about 1740L. As CAT's B-908 took off from LG at 1735L, we immediately sought contact over VHF B channel and advised ATC to ascertain B-908's whereabouts.



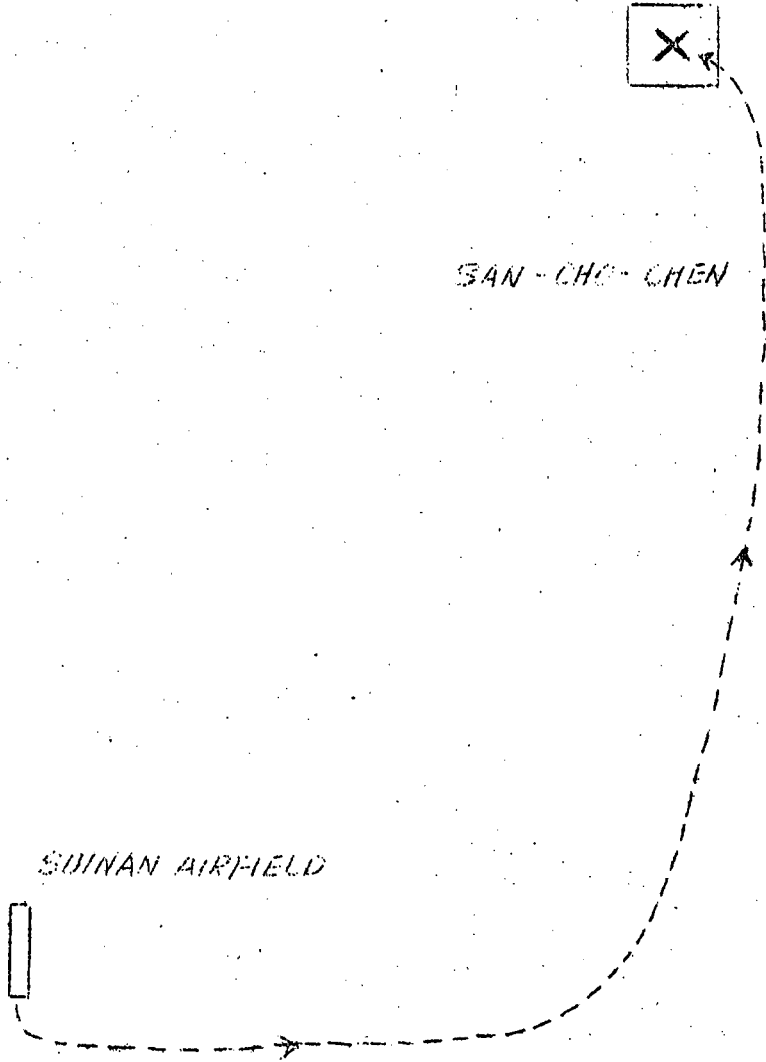
KUNG KUAN AIRFIELD

CRASH SITE



SAN-CHO-CHEN

SUNAN AIRFIELD



1. Flight Plan

- (1) Flight: Instrument
- (2) Aircraft: 908
- (3) Aircraft type: C46
- (4) ETD: 200000Z
- (5) Depart TPE 140 knots, 4000 feet, 40 minutes, A-4 to TCG.  
Depart TCG 140 knots, VFR, 40 minutes, A-4 to TNN.
- (6) Alternate airfields: Taipei, Tainan
- (7) Time needed for letdown at first stop: 40 minutes
- (8) Fuel: 3:40 hours
- (9) Radio transmission: Standard
- (10) ILS, VOR, Radio Compass
- (11) Total number of persons aboard: 57
- (12) Pilot: B. Lin
- (13) Airline: CAT

The above cable was sent by Taipei Flight Information Center at 192322Z to Taipei Area Control.

2. C46 B908 departed TPE for TCG 0005Z (schedule departure time 0800L).  
This cable was sent by TATS at 0006Z to CAF Base.
3. C46 B908 TPE/TCG arrived TCG 0845L (schedule arrival time 0835L).
4. C46 B908 departed TCG VFR for TNN 0858L (schedule departure time 0845L).
5. C46 B908 TCG/TNN arrived TNN 0930L (schedule arrival time 0920L).
6. C46 B908 departed TNN for MKG 1003L, 25 minutes' visual flying, fuel 3:30 hours (schedule departure time 0945L).
7. C46 B908 arrived MKG from TNN 1024L (schedule arrival time 1010L).
8. C46 B908 departed MKG for KAO (Hsiaokong) 1041L (schedule departure time 1025L).
9. C46 B908 arrived KAO from MKG 1115L (schedule arrival time 1100L).
10. C46 B908 departed KAO for MKG 1130L (schedule departure time 1110L).
11. C46 B908 arrived MKG from KAO 1200L (schedule arrival time 1145L).
12. C46 B908 departed MKG for TNN 1558L (schedule departure time 1600L).
13. C46 B908 arrived TNN from MKG 1618L (schedule arrival time 1625L).
14. Flight Plan

C46 B908 depart TNN, 140 knots, VFR, 40 minutes to TCG thence to TPE, ETD 1600L, fuel 4 hours, radio transmission standard, Pilot B. Lin, crew 5.

15. B908 C46 departed TNN for TCG 1648L, 40 minutes' visual flying, fuel 4 hours (schedule departure time 1640L).
16. C46 B908 arrived TCG from TNN 1722L (schedule arrival time 1715L).



Letter No. 53-091

Date: June 24, 1964

To : Civil Aeronautics Administration  
From : Office of Inspector General, Chinese Air Force Headquarters  
Subject: CAT C-46 B-908 Accident Data

1. Reference is made to your June 22 telephone request for assistance in the investigation of CAT C46 B-908 accident.
2. Enclosed please find a set of the data as obtained from the scene of crash.

Y. C. Mao  
Lt. General  
Inspector General

CHINESE AIR FORCE DATA ON CAT C-46 B-908 ACCIDENT

1. On June 20, CAT's round island flight (TPE/TCG/KAO/MKG/KAO/MKG/TNN/TCG/TPE) departed Taichung's Suinan Airfield at 1735L, carrying 52 passengers and a crew of 5 for a total of 57 persons. About 3-5 minutes later, the aircraft crashed some 5 miles northeast of Suinan and was completely destroyed. All aboard were killed.
2. The crash scene was a rice paddy in San-Cho-Chen about 5 miles NNE of Suinan. The impact and testimonies of witnesses at scene of crash indicate that the aircraft had made a left turn and had struck the ground at an angle in a descending slope. The aircraft disintegrated upon impact, and debris was thrown over a 10-foot ditch and scattered in the paddy beyond. The azimuth of ground impact was approximately 240 degrees.
3. The broken state of the aircraft remnants indicates the severeness of the force of impact. Both engines were located, one having broken into pieces and the other in relatively integral condition. Both landing gears and flaps were in up position. None of the instruments was intact to permit further study.
4. There was no evidence of extensive burning upon impact. According to eye-witnesses, the fire was not great, only slightly bigger than the size of black smoke from train engine, as seen at a distance. This was supported by the fact that only a few aircraft remnants showed signs of burning.
5. After taking off in a southerly direction, the aircraft completed a 180° turn, proceeded on course and contacted Suinan Tower to report on-course flying and leaving channel, further saying goodbye to the Tower. The duty tower controller noticed all was normal with the aircraft. It made no further contacts with tower who further stated that there was nothing abnormal about the aircraft prior to leaving tower control, such as fire or smoke.
6. Witnesses at crash scene were interviewed and none definitely admitted having seen the plane crash, because the residents are accustomed to plane noise. Only a woman by the name of Cheng, who was digging vegetables about 1000 meters away, saw the plane suddenly bank to the left and hit the ground. Her statement appeared credible.
7. The point of impact to the farthest place of remnant measured only 200 meters, with a width of about 50 meters. This proves that the aircraft disintegrated upon impact, not in the air.
8. From the foregoing, it could be proved that:
  - (1) The aircraft was in fine condition at time of takeoff till flying on course and contact with tower.
  - (2) The trouble occurred when it flew on course, i.e., on the third leg of the traffic pattern. Estimated time of trouble was between 3 to 5 minutes after takeoff; estimated altitude was approximately 1500 feet.

- (3) As the aircraft proceeded on course at about 1500 feet, it possibly developed trouble. The aircraft then had the Feng-Yuan hilly region on its right and some houses, ditches and trees in the front. The pilot appeared to have attempted to a left turn to return for a forced landing at Suinan, but the aircraft stalled in the course of the turn and crashed.
9. There are many possibilities of aircraft trouble and before the aircraft parts are carefully examined, evaluation could be made only to the aforesaid extent.

Translation of summaries of statements made by U.S. FAA's Mr. J. R. McBride and Mr. D. H. Wilham and USAF's Capt. Goldey at the first Accident Inquiry Board meeting convened on June 25 afternoon at 4 o'clock by the Civil Aeronautics Administration.

- (I) C-46 type passenger airplane No. B-908 was involved in a mishap in the vicinity of Taichung on 1964 June 20 afternoon at approximately 5:40 hours. Matters pertaining to the airplane, flight crew, flying hours, weight carried, manifest, etc., will be provided by CAT, so they will not be described.

We will commence with certain conditions seen by two eye witnesses, Lt. Col. Davis and Major Wells. They saw the first turn to east and second turn to north after the airplane took off from Taichung Sui-Nan Airfield from north to south, until the airplane was obscured by trees. During this period of observation, they saw no emanation of smoke or fire, or evidence of control difficulty. From what was seen we presume that for an interval of at least two minutes after takeoff, the airplane should not have encountered any kind of flight difficulty. The authorities should concentrate their efforts to determine whether there is any record or information available from eye witnesses of the period between completion of the second turn until the instant of the mishap. Written accounts of the above two witnesses could be separately obtained for record.

- (II) Investigation of the aircraft crash site follows. All signs of impact and scatter of the wreckage pointed to 280 degrees. The left wing left a mark in the paddy field deeper than the thickness of the wing and similar in shape to the wing. The 2-foot high rice plants leaned 30 degrees (the angle was measured with an inclino-meter), photographs were taken. The right wing crashed through tree branches and cut off a branch of the tree. The angle of the cut was measured as 37°. The distance between the centerline of the fuselage impact point and the left wing impact point (Translator's note: No mention was made of the exact measuring point) was 63 feet and the perpendicular distances from the extension of the centerline to the crashed left and right wing tips were 57 feet and 51½ feet respectively. Based on the aforementioned findings and on-site analysis, we conclude and believe that the aircraft impacted in the manner of "left wing low" and "nose low with a relatively large dive angle".

- (III) Next was examination of the tail section wreckage. This part was comparatively intact. The horizontal stabilizer, rudder and trim tabs suffered minor damage. The rudder trim tab deflected only a half inch from neutral position (may be considered no trim). The left elevator was at the trim tab and torn inward, the trim tab was at an angle of 35° with the horizontal line which was a "nose up" condition. The right elevator trim tab was also measured at 35° but in the "nose down" condition. All control cables to the screwjacks were examined. In the left screwjack, the control cable was wrapped around the last groove toward the rear of the aircraft. In the right screwjack, the control cable was wrapped around

the first groove toward the front of the aircraft. It was found that both left and right sides had one loose control cable. After pulling them out for examination, it was found that both control cables were broken at a distance of 7 to 8 feet from the screwjacks. Sections of the aforementioned control cables where they broke were taken for dispatch to the U.S. for a more thorough analysis of the cause of severing. The result of the analysis will be sent to CAA and CAT. The part of the left elevator which was torn off was found at the mid-point between the initial impact point and location of the tail section wreckage.

- (IV) In the next part of our examination we entered the fuselage center section. This section crashed and came to rest at a location about 150 to 200 feet forward of the other wreckage mentioned above. This section has been thoroughly examined to see if there was any melted metal which would prove whether the aircraft caught fire in the air. So far there is no evidence of fire in flight. The only serious fire damage was found in one of the wings. We found a comparatively small amount of melted metal.
- (V) The left engine propeller hub has been examined and it was found that the propeller blades were torn off outward. Examination indicated that the breakage occurred after impact. The right engine propeller hub was also examined, the condition of the breakage of its propeller blades was the same but it was broken toward the left side.
- (VI) For the record, the last part we checked was the cockpit. Only one altimeter was found, showing barometric pressure 29.72 and altitude 300 feet. Later it was found that these figures were the local barometric pressure and the level of the crash site above sea level. These figures were not considered to be a cause of the crash. The cockpit suffered the worst damage and fragmented into many pieces. So far another instrument, a turn and bank indicator, was found and examined, but nothing significant was obtained because of the heavy damage.
- (VII) This paragraph concerns the pistols hidden in radar instruction books. Since the matter has been covered by a report from the security authority, it is omitted here.
- (VIII) We would like to take this chance to offer a suggestion to Chinese authorities that the autopsy is the most important part of an aircraft mishap investigation. We hope that this kind of air disaster will never happen again in Taiwan. We suggest that the police give effective assistance by urging the authorities concerned to reach the site as rapidly as possible to complete the autopsies, especially of the flight crew members, so that valuable information may be obtained by the aviation authorities in charge of investigation of the mishap.

MINUTES OF FIRST MEETING OF ACCIDENT INQUIRY BOARD

I Time: 16:00 25 June 1964

II Place: Projection Classroom, International Airport, Taipei

III Attendants:

Shen Yi, Minister of Communications  
Tsao Sheng-Chie, Chief, Department of Navigation and Aviation,  
Ministry of Communications  
Hu Chie-Cheng, Chief, Air Transport Section, Ministry of  
Communications  
Lai Hsun-Yen, Director, Civil Aeronautics Administration,  
Ministry of Communications  
Chao Tin-Kwei, Chief, Flight Safety Division of CAA  
Chen Nei-Nyn, Chief, Flight Facilities Division, CAA  
Tien Wen-Chao, Chief, Air Traffic Control Division, CAA

IV Observer Experts:

Captain H. F. Goldey, USAF  
J. R. McBride, USA, FAA  
D. H. Wilham, USA, FAA  
F. E. Hartquist, Civil Aviation Section, Military Aid Advisory  
Group  
Kuo Te-Tseng, Inspector General's Office, Chinese Air Force  
Headquarters  
Chung Shu-Mei (Absent, report in writing was submitted)

V Observers:

Civil Air Transport Company Limited:  
D. Gluskin, Special Assistant to President  
T. L. Boyd, Vice President, Flight Operations  
Air Asia Company Limited:  
A. Wueste, Vice President, Technical Services  
Civil Air Transport Company Limited:  
W. R. Lasser, Director Flight Research  
D. E. Teeters, Chief Pilot  
P. K. Mei, Assistant Director, Sales and Services  
R. C. Chase, Chief, Flight Operations  
K. T. Mok, Chief, Quality Control  
H. Y. King, Assistant to Director, Traffic Division

VI Chairman: Lai Hsun-Yen

Recorder: Wang Chi-Fu

VII Remarks by Chairman:

In this conference we will proceed according to the following order:

- (1) Weather Factor
- (2) Air Traffic Control Factor
- (3) Aged/old aircraft
- (4) Overload Factor
- (5) Explosion in the air
- (6) Fuel Factor
- (7) Human Factor

First the investigators at the site presented their reports, questions were raised for discussion. It was decided that the investigators present analytical data.

VIII Discussion:

In conclusion, the following three areas are most worthy of further investigation:

I Control Cable: The American expert will mail the broken portion of the control cable to the United States for inspection. When we receive a reply the condition will be known.

II Engine: The wrecked engines were shipped to Tainan where they will be inspected by experts.

III Question of the Guns.

A. The experts recommend coordination with the police and, when necessary, asking the police to provide information.

B. Recommend that the Police perform autopsy (including determination of whether or not there was sudden illness).

ANALYSIS MADE AT MEETING

<u>Cause of Mishap</u>	<u>Decision</u>	<u>Reasons</u>
Weather	Weather is not the cause of the mishap	According to the weather information of the Taichung Control Tower (Sui-Nan): Visibility 10, (1) 20, (11) 120, SW 6, 29.72 According to information of meteorological observatory: 0900Z Taichung: Cloud coverage 5/8, Wind Direction 230°, Wind Speed 6, Visibility 10 (no change taking place), 2/8 cumulus 2000, 5/8 Altocumulus 12000, temperature 31°, dew point 26°, altimeter setting 29.72. 0900Z KungKuan: Cloud coverage 6/8, Wind Direction 230°, Wind Speed 16, Visibility 15 (no change taking place), 1/8 cumulus 2500, 6/8 cirrus, temperature 29°, dew point 24°, altimeter setting 29.72. At that time in Sui-Nan and Kung Kuan airfields, the visibility was very good, wind speed was moderate. The weather was good and not changing. Therefore, weather is not the cause of the mishap.
Air Traffic Control	Air traffic control is not the cause of the mishap	According to the report of the Sui-Nan Control Tower: The aircraft took off from No. 18 runway (from north to south) for Taipei. It left the airfield traffic pattern soon after takeoff, and called the

control tower on the VHF "B" channel: (C.T 908 leaving the channel, see you tomorrow!) The control tower contacted Kung-kuan Control Tower which confirmed this point. At about 17:40L, the control tower discovered black smoke which arose from the ground at a location northeast of the airfield. The control tower immediately called the aircraft by radio. There was no answer. At the same time the Kung-Kuan control tower was asked to immediately notify the concerned units for search and rescue. The above circumstances indicate that air traffic control is not the cause of the accident.

Overweight

It was not overweight. Even overweight, it will not cause a mishap on normal take-off or climb.

The authorized maximum take-off weight of C-46 aircraft is 48,000 pounds (50,000 pounds for military use). The maximum take-off weight of the aircraft at the field elevation of Taichung is 47,747 pounds. During the Taichung to Taipei flight, the aircraft was loaded with a take-off weight of 45,994 pounds, which was an unused load of 1,753 pounds under the permissible take-off weight. Therefore, the aircraft was not overweight when taking off from Taichung.

Outside rumors of aged and old aircraft

C-46 aircraft, manufactured during World War II, and pre-World War manufacture DC-3 aircraft (the military type known as C-47) to this day are used in civil aviation in many countries. They are also used as transport aircraft by the Air Force. Even the forerunner in civil aviation, America, is still using this type of aircraft. In the period immediately after World War II, aircraft manufacturers have tried to design new type of aircraft to replace the existing types described above for use in short ranges. Although there were the Martin 204 and 404, F-27 etc. types of aircraft, they never turned out to be better than the DC-3 and C-46 in every feature. After World War II, the jet airplane which was



suitable for long ranges came out but it is not suitable for short range use such as the Round-the-Island flight. Therefore, the question of whether the aircraft is aged or old does not depend on the time of manufacture, but should depend on evaluation of whether any evidence of hidden fatigue exists in the airframe, engine, components and parts. If all the components and parts can be changed according to the time limits prescribed by the manufacturers, fatigue will not develop, and the aircraft will be like a brand new one. The effective date of the Certificate of Airworthiness of B908 was until 29 October 1964. It was in the airworthy condition.

Overload

It cannot be the cause of the mishap

The aircraft has 53 passenger seats and 5 crew seats (3 of them in the cockpit and 2 in the cabin) and the arrangement of the seats conforms to weight and balance safety. There were 52 passengers aboard the aircraft when it took off from Taichung; 16 passengers that boarded in Taichung, 15 in Tainan, 21 from Makung to Taipei plus 5 crew, making a total of 57 persons. The total number of seats was 58, so 1 seat was vacant. Each seat was provided with a safety belt for use by the passenger during take-off and landing. It is the responsibility of the attendants to pay attention so the passenger will not move around. Therefore the mishap was not caused by overload.

Outbreak of fire in the air

According to what a witness at the site said: The aircraft overflowed my house. I saw the left wing was inclined, but there was no smoke and fire. According to recent radio broadcasts, there was no witness who reported observing any fire in the air. At the impact area, no burnt or melted metal was discovered. There was no evidence of backward flow of molten metal. At the same time the Sui-Nan control tower said that the aircraft was in good condition from the time of take-off until the time of leaving radio contact.

STRUCTURES INVESTIGATION REPORT  
CONCERNING ACCIDENT TO CIVIL AIR TRANSPORT  
C-46-DM, B-908 NEAR TAICHUNG, TAIWAN,  
ON JUNE 20, 1964

INTRODUCTION

This report contains the observations made by examination of the wreckage of C-46-DM, B-908, at the Air Asia facilities in Tainan, Taiwan, during the period from July 4 thru 11, 1964.

To facilitate the examination the many pieces of wreckage were laid out on the ground according to the shape of the airplane to make up separate models. The owner's other models were also used for reference. The fuel tanks were positioned on the ground forward of the corresponding wing in the main model. The owner's model installation remained controls outside, crew seats, cabin seat broken parts, and the landing gears.

SUMMARY

1. The airplane structure was severely disintegrated by crash impact forces acting rearward, upward, and to the right on the airplane.
2. No indication of fatigue cracking was found in any of the structural wreckage, with the possible exception noted in Item 6 below.
3. Numerous joints had been loosened for transportation prior to the examination at Tainan, making the examination for any disconnection in service slightly more difficult than examination for this condition would have been at the scene of the accident.
4. No indication of in-flight fire was seen in the structural wreckage or interior equipment.
5. There were only a few pieces of structural wreckage bearing evidence of relatively light and short period fire and/or heat damage after the accident. These were in the right outer wing forward of the aileron, the left wing center section, the left side of the vertical tail, one piece of wreckage comprizing the outer section of the left elevator, and the lavatory area of the passenger cabin.
6. The testing examination of the left elevator trim tab steel cable fracture clearly showed fractured area hitting this cracking was possibly due to prolonged repeated operation over a binding pulley or a rubbing surface. It was also possible some steel cables fractured separately, including fatigue cracking.
7. The aileron down cable, 3/16", which attaches to the differential bell crank in the wing forward of the aileron, separated 47 inches from the bell crank attach bolt with extensive fraying. This portion and the matching end of the fracture were removed for laboratory examination of the cable failure by the CAB metallurgist in Washington.

JOHN F. PAHL  
Chief, Engineering Division  
Bureau of Safety  
Civil Aeronautics Board  
Washington, D.C., U.S.A.

RESULTS OF EXAMINATION

Main Entry and Cargo Door

The main entry door remained in one piece with distortion of the lower part and the rear part of the inside lining pulled loose and distorted. A two foot portion of the forward cargo door remained attached to the main entry door by the upper door hinge. The lower hinge was broken. The inside handle of the main entry door operating mechanism was found in approximately the door open position being 10° short of the straight up position and was jammed in this position by the rear portion of the circular plate being bent forward over the handle. The surface of the cabin side of this handle was practically free of any marring or other indication of loading by any hard object. The outside handle was in the corresponding position and the entire latching mechanism was intact except that the rod to the bottom latch pin was bent in the area where the door was distorted and the rear and top latch pins were out of position. At the rear latch pin position the door frame was broken and distorted, being curled both up and down at the break. The top latch pin was found to be protruding approximately one-half inch through the door frame, having punched through from the inside at a point approximately 2" inboard and slightly aft of its normal location. The door frame was broken in line with the forward edge of the hole through which this latch pin normally protrudes.

The inside handle and inside cover of the door were removed to permit detailed inspection of the operating mechanism. This mechanism was intact and in operating condition except for the previously mentioned damage to the lower rod and the latch pins. The rear end of the "CLOSED" plastic placard was broken off through the rear attach screw hole. The inner surface of the circular plate was not marked by the door handle except through on one from about 10° to about 20° from the fully "OPEN", position of the handle.

The top latch hole for the main entry door was undistorted. The rear hole was deformed at the bottom corner. The bottom hole was distorted at the outer (flat) edge.

All four of the pin type latches on the bottom of the front and rear cargo doors were found in the extended, "CLOSED", position and most of them jammed in this position. Three of the toggle latches were still attached and in operating condition but the rear one on the rear door was torn off and missing.

Three latch pin holes in the door sill for the cargo doors showed no noticeable distortion; the most forward one was not found. The most forward plate for the toggle latches also was missing, the next two were torn out and the most rearward was intact and undistorted.

### Passenger Cabin

The condition of all of the 53 seats and two attendants' seats were generally speaking: the leg structures were buckled and broken due to loads acting to the left, downward, and forward and with the legs separated from the wedgit fittings. Most of the seat belts were unbuckled without any noticeable damage due to high impact loads, although several remained buckled and two were cut through the webbing after being mud splattered. No indication of fire damage or other damage than that consistent with crash impact destruction was noted.

The other wreckage from the cabin area disclosed no evidence of damage other than that due to crash impact loads except that in the extreme rear end two indications of burning were noted. One instance of this was burned fragments of fibreglass insulation and one small section of cabin lining remaining attached to the upper fuselage shell between Station 688 and 704 in the lavatory area. Scorching and charring was predominant at free edges of the torn material in a manner consistent with short period burning after crash impact. The painted skin in this area showed only very minor indication of heat damage, most of it being in the zinc chromate finished area normally covered by the dorsal fin which was free of fire damage.

The other instance of fire damage was found in the left side of the fuselage, its position being the fibreglass insulation between Stations 651 and 688. The edges of paper towels in a container in this position were charred. However, the condition of charring of the fibreglass insulation was most evident on edges of torn and exposed parts, with little or no damage to the areas wedged into folds of the crumpled skin. This is indicative of very short period exposure to burning after the crash impact damage occurred.

### Access Door from Cabin to Cockpit

This inside access door to the cockpit was broken out of its door frame, the hinge remaining on the door, and the lower half of the door was fragmented. The spring latch and handles were in fair condition. The slide bolt on the cockpit side was missing from its housing, without any noticeable deformation of the housing to indicate the position of the bolt at the time of the crash. The portion of the slide bolt housing on the door frame was not found.

### Crew Entrance Door

The crew entrance door was found nearly intact with the latch pins and operating mechanism in the extended, door "CLOSED", position. The upper latch pin was displaced forward by crash impact loads. The two hinges were torn out of the door.

### Crew Seats

Crew seats became numerous fragments. There was one seat back. All showed no evidence of any damage other than that due to crash impact. There were a few parts of one safety belt still attached to a broken piece of the seat. The other part was also attached to the seat. One spot showed indication of high loading. The above safety belt was black Air Associates type buckle. There was another safety belt in red color with metal buckle, found still attached to seat frame. The webbing and fittings were not damaged.

### Crew Seat Tracks

Four crew seat tracks with small pieces of floor structure attached were located. The tracks were not identifiable as to pairs or right and left positions. All were broken through the most rearward hole. Two was broken through the most forward hole and one of these two had a third break through the fourth hole from the front. A third one was broken through the second hole from the front and the fourth one was broken through the fifth hole from the front. There is no apparent pattern to the track breaks by which seat positions on the tracks at the time of impact.

### Wing Structure

The wing structure was broken into numerous pieces, all of the deformations and fractures being consistent with essentially rearward acting ground loads. In general, there was remarkably little fire damage. There was one small burned area on the top surface area which had covered the rear fuel tank. There was relatively light fire damage in the outer portion of the left center wing structure. Three pieces of right outer panel skin forward of the aileron had the exterior paint charred and burned off in some of their areas. However, there was no continuity of fire damage across tears of mating pieces, indicating that all of the observed fire damage on the wing occurred after the accident.

### Flaps

The four wing flaps received moderate crash impact damage and remained attached to sections of wing structure forward of each flap. However, the lower chords of the out bracket for the right inboard flap and of the inboard brackets for both outboard flaps were fractured just aft of the spar attachment. In addition the inboard end of the right outboard flap was mangled and separated from the rest of this flap. No fire damage was noted on the flap wreckage. All four flaps were in the retracted position at the time of the accident as indicated by the retracted positions of the hydraulic actuator struts.

### Ailerons

The right aileron was torn into 6 pieces by crash impact forces, one of which just outboard of the tab was missing. No fire damage, not even to the fabric covering, was noted. All 6 hinges were broken in random patterns, but the hinge bolts connected parts of both wing and aileron fittings in all cases. The entire tab was still attached to one portion of aileron by means of the complete piano hinge. All sections of the counter balance weight remained attached to the leading, except short sections bridging breaks in the aileron.

The left aileron was torn into two pieces. The separation occurring just outboard of the No. 3 hinge. The Nos. 1, 2, and 3 hinges still attached the inboard section of aileron to wing trailing edge and rear spar structure. Portions of the No. 4 and 5 hinge brackets were separated from wing structure and still attached to the outboard section of aileron by means of the hinge bolts. The bearing was broken out of the No. 6 hinge fitting riveted to the aileron and all portions of the bracket forward thereof were missing. The counterbalance weights remained attached to the aileron leading edge throughout their entire length. There was no fire damage to the left aileron. The tab remained attached to the inboard section of the left aileron by means of the complete piano hinge.

### Landing Gear

The tail wheel retract strut was found with the piston rod bent in the fully extended position which corresponds to the gear retracted position. The wheel and tire remained intact and attached to the tail wheel assy. The right main landing gear strut showed no significant damage the inner cylinder appearing to be unbent. The uplatch bolt on the dog leg was bent toward the upper end of the strut. The left main gear strut was in comparable condition, except that the uplatch bolt appeared to be straight. The left main gear uplatch was found intact and still attached to a portion of nacelle wreckage. Both main gear tires were torn by crash impact loads with no indication of prior blowout. The left wheel brake drum rim was crushed inward in one area by crash impact loads. This area was in line with the tire tears. When examined at Tainan the left main gear retract strut was in the extended position with the rod end fitting broken off. The right main gear retract strut was in the compressed position without damage restraining extension. It was reported that when first observed after the accident both main gear retract struts were in the fully extended position, which corresponds to gears retracted.

### Right Horizontal Tail

The right horizontal stabilizer had been cut from the aft section of fuselage by means of a torch prior to transportation to Tainan. It was reported that the elevator had been disconnected from the stabilizer by removal of the No. 1 hinge bolt, the Nos. 2, 3 and 4 hinge bearing block bolts, the bolts connecting the elevator torque tube to the elevator, and the bolts at both ends of the spring tab pushpull tube extending from the elevator floating horn to the spring tab bell crank at the end of the torque tube extension.

The right horizontal stabilizer was undistorted except for rearward flattening of the loading edge over a six foot span by crash loads and inward crumpling of the tip section by crash impact loads. The Nos. 1, 2 and 3 hinge brackets remained intact without noticeable distortion. The No. 4 hinge bracket was displaced inward with an inward bend several inches aft of the stabilizer rear spar and an outward bend just forward of the hinge fitting. The paint on the outer surface of the stabilizer was not distorted by heat or fire, but the fabric patches covering three holes in the closing skin just forward of the elevator leading edge were brittle from heat charring.

The only significant damage to the right elevator was distortion of the area from the No. 3 hinge to the tip in a manner consistent with the ground impact damage to the stabilizer tip and the distortion of the No. 4 hinge. The damage consisted of inward buckling along a chordwise line just outboard of the No. 3 hinge, upward displacement of the surfaces aft and inboard of the No. 4 hinge, with a compression buckle in the upper skin extending inboard and aft from the No. 4 hinge, and upward displacement of the elevator tip section outboard of the No. 4 hinge. At both the Nos. 3 and 4 hinges the leading edge upper skin and nose ribs were deformed by interference with the bottoms of the corresponding hinge brackets as the outer part of the elevator accordianed inward due to the ground loads at the tip. When the wreckage was examined at Tainan the right elevator was in two pieces, having been served along a chordwise line approximately 23" inboard of the No. 4 hinge. However, it is obvious that this was done by cutting, hacking and bending after the previously described impact damage had occurred.

The spring tab remained attached to the right elevator by all three hinges and the counterbalance was intact. However, the tab skin was buckled just outboard of the counterbalance with the inboard end of the tab and the counterbalance displaced about 10° nose down relative to the rest of the spring tab. The spring tab push-pull rod was still bolted to the tab horn and to the bell crank at its forward end. The spring tab cartridge also was still properly installed and was the correct right hand part. The bell crank was undamaged and properly attached to the bracket at the end of the torque tube extension. It was reported that prior to removal of the horizontal tail surface from the aft fuselage at the scene of the accident the entire spring tab and the spring tab control assembly were in operable condition. Nothing observed during examination of the wreckage at Tainan would indicate otherwise.

The right elevator trim tab was in one piece but distorted in a manner consistent with the previously described ground impact damage to the elevator. The inboard and center hinges were intact, still holding the tab to the elevator. However, the lugs of the outboard hinge fitting attached to the elevator were broken off at the hinge bolt which remained in the fitting attached to the tab, the broken off portions of the lugs still remaining with this assembly. This hinge fracture was consistent with the ground impact damage to the elevator.

The right elevator trim tab push-pull rod was still bolted to the tab horn, but the idler at the elevator hinge line had been unbolted from both the push-pull rod and the pivot fitting. The idler was of proper type and in good condition. The trim tab shaft forward of this idler was still attached to the trim tab motor. The latter was properly installed in its mounting bracket with the pivot studs properly safetied. The tab motor was in operable condition with the cables leading off the drum at its forward end which corresponds to the tab full "UP" position. The upper cable extended approximately 12'6" from the cable drum where it terminated in a cut end. The upper cable extended approximately six feet from the drum where it terminated in a cut end. It was reported that a short section of cable with a broken end was cut from one of these cables for Mr. McBride of FAA to be examined in the laboratory.

Results are as follows:

This section of cable and the one cut from the left elevator trim tab motor were examined by the CAB metallurgist, Mr. W. Holshouser, in Washington who reported, in substance, the following:

Cable sections are standard twisted steel one-eighth inch aircraft cable, seven strands, seven wires to strand.

Right left elevator trim tab steel cable indicated it received overload tension and fractured. Before it received overload tension and fractured, there was no indication of significant damage and failure.

Left elevator trim tab steel cable, the entire 8-inch long sample indicated previous wear. All exposed steel wires of outer strands on the periphery were worn to about one half of their original radii. In the last half inch preceding the raveled end, there were 13 wire ends forming straight lines. The center strand of the steel cable fractured due to pure working force. There was no indication of previous breakage received or wear. The conditions of the other six outer strands were as follows:

1. Of seven wires, four wires were worn completely through at one point. Two wires fractured due to tension. The other one (the 7th) was cut previously.
2. One steel cable was 80% worn prior to fracture. Four wires fractured due to tension. Two wires severed earlier by wear in the unraveled area.
3. Three wires have cut damage. One wire was worn through. One wire fractured due to tension. Two wires separated in the unraveled area.
4. Three wires have cut damage. Two wires fractured. Two wires broke apart in unraveled area.
5. One wire was worn through. One wire was cut damaged. Five wires fractured due to tension.
6. Five wires fractured due to tension. Two wires were disconnected in unraveled area.

Left steel cable wear and cut damage pattern indicates on fixed pulley to sliding, turning divided pulley, axle or other similar steel cable problem.

#### Left Horizontal Tail

The left horizontal stabilizer was cut from the fuselage by means of a torch prior to transportation to Tainan. In addition, the stub end of the elevator with spring tab was unbolted from the inboard hinge and the elevator torque tube. Also, the spring tab cartridge, the bell crank to which it attaches, and the push-pull rod extending into the fuselage were removed.

Almost the entire leading edge of the left horizontal stabilizer was crushed by rearward and upward acting ground loads. In addition the stabilizer structure was folded upward about a diagonal line extending from about Sta. 80 at the leading edge to about Sta. 130 at the rear spar. The stabilizer tip was torn off by ground impact loads with little damage except rearward crushing at the leading edge. The inboard, No. 1, hinge bracket remained intact with no noticeable distortion. The No. 2 hinge bracket was bent upward and broken, but remained attached to the stabilizer and elevator separately. The No. 3 hinge bracket broke loose. The hinge bolt was broken. The other outer hinge brackets were bent and broken.

The left elevator was separated into two pieces by crash impact and was bent. The outer portion was missing. The hinges were distorted and displaced. The surface appeared in a charred condition because of the crash and because it was subjected to fire. The trim tab remained, but was already bent. The balance weights were in good condition.

The elevator upper leading edge was charred. But the inboard section remains attached to the stabilizer and fuselage and was not damaged. The spring tab and its push-pull rod remained in good condition.



The left elevator balancing trim tab, push-pull rod, remained attached in original position. The aft end of the shaft from its motor remained bolted to the idler. But the rod end was bent, shaft tube was broken. The trim tab motor was still installed on its bracket. The upper steel cable extended 32 inches. The lower steel cable extended 14 feet 4 inches. A section of this was taken by Mr. McBride of USFAA for examination.

#### Vertical Tail

The vertical tail was the "D" type with only a trim tab on the rudder, being separated from the fuselage due to ground impact. The rudder was removed after the crash.

There was no noticeable damage to the vertical fin. All hinge brackets were in fair condition. The paint on the surface of the left side was burned and the skin was annealed. Only a small left portion was not fire damaged.

The rudder and the fin were similar in nature. The skin was mostly subjected to fire. All hinge fittings and balancing weights were in good condition. When examined in Tainan, the rudder trim tab motor was removed. Its condition was fair. The rudder trim tab motor stopped in the neutral position. The steel cable on it was cut off about 3 inches.

#### Flight Controls

Control columns were broken into six major pieces and a number of small pieces. The above major pieces the control wheels remained. Left and right wheels were both in the left-wing-down position. Wheel hubs could be moved with force. All chains were still attached. The elevator control cable actuating arm was broken. The control column torque tube was broken in the front part. The bell crank was missing.

On the elevator bell crank, the ends of four steel cables were cut. The push-pull rod was separated from the bell crank but in good condition. The surface metal of the broken pieces showed coarse grain structure. Microscopic examination produced cracks on the finished surface. These cracks were close to the fracture due to impact stress in the area of a stamped number where prior fracture occurred due to fatigue. These cracks would not occur.

The elevator torque tube, push-pull rod, bell crank were in good condition.

The conditions of three rudder pedals and four control rods were generally like this: All control rods were broken. Apart from one steel cable, all the rest were not in good condition. All four pivot bolts were in their original positions. Push-pull rods were attached. Adjustment mechanisms were damaged due to impact.

The aileron distorted, control mechanism was broken into six pieces. The three bell crank arms to attach the right side cables were broken. The crank for attaching the left side cables was bent upwards 40 degrees.

The two steel cables from the cabin connecting to the right side remained in their original positions. Those connecting to the left were also undamaged. But their bolts were missing. The cable turnbuckles were found with bends. Aileron adjustment steel cable remained in its original position, but was knocked off its bearing. The clevis end was still attached to the control rod for the right aileron. But the clevis was bent and the threads were clean, while the clevis itself was muddy. This indicates the turnhandle barrel was detached after the accident. The hydraulic installation was broken, the attach fittings remaining in place. But the hydraulic piston could be moved in its cylinder. Hence, its position was meaningful after the investigation.

The aileron differential bellcrank, when examined at Tainan, was in good condition but separated from its mounting bracket. The pivot bolt was missing. But it appeared that the pivot bolt was removed after the accident, rather than having failed in the accident or having been missing prior to the accident. The steel cable was still attached but extensively frayed. This steel cable section was removed for examination in Washington, U.S.A.

The rear 1/4" steel cable was separated from the differential bell crank, the ball bearing having been forced out, with noticeable damage of the hole for the bearing. The forward push-pull rod was still attached by its bolt, but the push-pull rod itself had been loosened without damage to the threads. The check nut remained on the rod.

The left wing differential bell crank was found detached from the wing structure steel cable. The cable fitting remained attached to the bell crank. This indicates that the cable terminal disconnected at the crash. The pivot bearing was missing. All mounting brackets were broken and missing. The aft end of the push-pull rod remained attached to the aileron horn.

The left aileron trim tab mechanism remained intact in a section of wing rear structure and aileron, but the push-pull rod was separated from it. The steel cable ends were frayed.

The right aileron trim tab motor was found lying loose behind the trailing edge of the right wing. The mounting bracket was bent and deformed, but remaining fixed in original position. The motor itself was intact, but the shaft was bent about 25°. The idler and push-pull rod were still attached to the motor. There was damage on the periphery of the idler. The trim tab cable was at its mid position, indicating that there was no deflection.

The cockpit control for the aileron trim tab was found jammed in the neutral position with the hand wheel broken off. The control mechanism for the elevator was found in the neutral position. The mechanism could be turned about one-half. The control mechanism for the rudder trim tab was missing.

There were still numerous assorted steel control cables remaining in the wreckage. But there was none indicating any abnormality and condition of damage due to impact forces.

Rudder Controls in Aft Fuselage

The rudder controls in the aft fuselage were not removed when they were transported to Tainan. All parts were still in good condition.

The rudder steel cables were broken. But the cables on the right side showed serious elongation at the 6'9" spot, indicating that they were bent over some obstruction under excessive load. The rear stop bolt was bent 90 degrees. The rear forward bolt was broken. The first bell crank handle was damaged due to abnormal loading on both sides. The link rod between the two bell cranks was slightly bowed by abnormal loading.

INVESTIGATION REPORT OF EXPERT MR. HALLMAN

SUMMARY OF INVESTIGATION OF POWERPLANTS

CIVIL AIR TRANSPORT C-46 TYPE AIRPLANE ACCIDENT

The investigation of the powerplants was conducted at the Air Asia facility at Tainan. Details of the investigation are reported in a comprehensive report.

No indications of fire damage either prior or subsequent to impact was noted on either of the engines or adjacent accessories.

Both engines had separated from the nacelle structure, and each engine rearward of the power case had separated into two. Of the propellers, the hubs remained on the front engines. However, the left propeller power gear and the power unit adaptor plate remained in the hub. Blades of propellers and the power unit of the right propeller were recovered. Extended efforts to locate the left propeller power unit have not been successful as of this writing.

After propeller hubs were removed, it was discovered that on the right propeller shaft, in the spline area immediately to the rear of the hub to the shaft engagement termination, there was noticeable twist in the clockwise direction. Otherwise, the propeller shafts including thrust bearings were normal in appearance.

The engine nose cases were removed for examination. The intermediate drive gear covers were scored partially across their surfaces from contact with reduction gear carried bolts. Cotter keys on these bolts were bent in the direction of rotation. It was evident that the reduction gear assembly had been forced rearward under impact loads; because the propeller oil transfer bearing supports were cracked or broken entirely from their front mounting flanges on the left and right engines. Otherwise all observations of the interior of the engines forward of the crankcase were normal.

Cylinder damage to both engines was similar in that it was centered about the lower left quadrant and consisted mainly of cylinders being forced rearward and off of their respective crankcase pads. Except for this obvious impact damage, all observations of the cylinder and piston assemblies and the interiors of the crankcases were normal. Cylinders were removed and their wicker box covers were in turn taken off to permit detailed examinations.

The rear cases were disassembled for a detailed examination. Some of the vanes of the right engine impeller were bent. Corresponding marks on the case as well as the impeller itself showed the impeller was not rotating when the marks were made. The left impeller

did not show any damage. Splines on the rear of the left engine crank shaft were wiped out for approximately  $180^{\circ}$  at their aft extremity. This damage resulted when disengagement of the rear accessory drive shaft occurred upon separation of the rear sections. The mating drive shaft splines showed corresponding damage. The crankshaft surface just aft of the splines was marked spirally. All other observations of these portions of the engines rearward of the crankcases were normal.

All oil screens and oil pumps were normal.

Of the left propeller power unit, except for the power gear and adaptor plate which were jammed in a certain fixed position in the hub, the other parts were not recovered. This fixed position was recorded, and subsequently emptied /apparently typographical error and "determined" intended/ to represent an approximate  $30^{\circ}$  blade angle. The right power unit was normal. Its motor operated normally in both directions. It was positioned at  $30^{\circ}$ .

Blade gear damage condition was related to blade angle. The place of damage of the blade gears corresponded approximately to  $30^{\circ}$  blade angle. One governor, two control relays, voltage boosters, etc. were all examined. The other propeller governor was not recovered.

Three magnetoes, both fuel control valves and engine driven fuel pumps were examined. The other magneto was not found. These units suffered varying degrees of impact damage, however no evidence of operational failure was observed. The pressure regulator diaphragm of the right fuel pump and the poppet valve diaphragms of both fuel control were ruptured. Also, the vapor vent floats were broken by pressure. These diaphragms and floats were subjected to the same pressure, and it is not unusual to find this kind of damage resulting from severe impact.

The manifold pressure gauge had only the dial and the pointers. The pointers were impacted with a spread of 0.25" Hg. The dial and pointers were deformed irregularly, showing the same kind of deformation at 40" of manifold pressure. Further study is required.

The tachometer was examined with a view to finding the engine RPM at the time of impact. The periphery of the pointer gears actually shows a few places of impact damage. If accurate determination of significant RPM is needed, further study is required. Under normal operating conditions, these pointers are comparatively movable. With the multiple gear damage, it is difficult to obtain a single reliable RPM reading.

All of the fuel tanks, except the right rear one were out of the wings at the time of examination. The right rear fuel tank was also displaced, its distance being approximately one-half of the diameter of the filler opening. The tanks were all damaged in varying degrees but were essentially intact. There were deposits in the tanks. The left front and the right center fuel tanks had localized melting of metal.

The auto-pilot servos were examined. Their piston positions were fixed by the bent piston rods except for the elevator servo which could be moved  $3/8$  inches. Control surface positions on a like C-46 were checked after these servo positions were established with the following results:

Aileron - Right aileron down  $6.7^{\circ}$   
Rudder - Rudder deflected right 3"  
Elevator - Elevator down  $1/2$ "

The above is the summary of my powerplant investigation report.

Signed: A. B. Hallman  
U.S. Civil Aeronautics  
Board